SURVEY OF THE XM RADIO ELECTROMAGNETIC SPECTRUM IN THE NORTHERN VIRGINIA METROPOLITAN AREA

Prepared For

XM Satellite Radio
1500 Eckington Place
Washington, D.C.

Northern Virginia
XM Frequency Band Testing

October 9, 2000 – October 19, 2000

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ONE

SECTION 1

EXECUTIVE SUMMARY

The purpose of the measurements performed in this project was to assess the current electromagnetic environment in the XM Satellite Radio reception band (2332.5 – 2345.0 MHz) to allow comparison to the equivalent input noise level (EINL) of the XM Satellite Radio receivers.

The results of the electromagnetic measurements and data assessment show that the band of operation for the XM Satellite Radio system is electromagnetically quiet enough at the present time so that the XM Satellite Radio receivers should be able to utilize it without suffering from degrading interference. The main source of interference in the band of interest comes from vehicle ignition noise. The ignition noise level is a function of proximity and number of vehicles in a given area. The vertically polarized levels of the ignition noise were generally higher than the horizontally polarized levels. The levels of ignition noise measured were sometimes above the EINL of the XM Satellite Radio receivers, but will have no effect upon the receiver operation due to the fact that they are random in timing and the radio receivers are designed to process time coherent pulses and they don't raise the average noise floor of the receivers. One other signal detected in the band was traced to a home intrusion alarm system installed by Brink's. This signal level was well below the EINL of the XM Satellite Radio receiver. No other signals were detected in-band that could be considered an interference threat to XM Satellite Radio reception.

These measurements were performed at preplanned sites in the Northern Virginia area over a period of two weeks in October 2000. The preplanned sites were chosen to provide a representative sampling encountered in a typical suburban environment from quite residential to heavy-use commercial locations, and were performed at various times throughout the daytime.

The Comsearch test equipment provided a reception capability with an isotopic sensitivity that is at least 20 dB better than the XM Satellite Radio receiver. The test equipment was installed in a company owned Ford Expedition, which served as the test bed for the test equipment and provided transportation from site to site.

Comsearch has been performing electromagnetic environmental measurements and assessments like the one in this project for over 20 years. Our company is recognized and respected by the telecommunication industry and the FCC for our work in this area.

SECTION

TWO

SECTION 2

TEST PROCEDURE

2.1 Calibration

Figure 3.1-1 is the block diagram of the 2332.5 GHz test set. All test equipment used was allowed a proper warm-up period prior to calibration. The test set was calibrated by the signal substitution method, as recommended by NSMA, utilizing a synthesized signal generator. The reference signal from the signal generator was adjusted for the frequency of test (2332.5 MHz) and measured with a thermal power meter for calibrated reference test level (-60 dBm). This calibrated reference signal from the signal generator was then injected into the end of the coaxial cable of the test set at the point, which normally connects to the test antenna. A spectrum analyzer then measured the reference test signal level after passing through the test set. At this point, the spectrum analyzer was calibrated such that the graticule of the spectrum analyzer display (-60 dBm) corresponded to the injected reference signal (-60 dBm) by utilizing the reference level offset function of the Tektronix 2782 spectrum analyzer. Upon completion of the calibration process, a known reference level was obtained for the measurements that corresponds to a given set of spectrum analyzer display readings.

The following formula is used to transform the measured signal level as read on the spectrum analyzer display (dBm) to an isotropic reference signal level (dBm_I) as seen at the point of test:

$$dBm_I = LI - GA$$

Where: dBm_I = Isotropic level in dBm

LI = Level (dBm) of injected signal

GA = Test antenna gain

at 2332.5 MHz:

$$dBm_I = -60 \text{ dBm} - 20 \text{ dB}$$

$$= -80 \text{ } dBm_I$$

In this instance, the spectrum analyzer displayed measured signal level of –60 dBm equates to a isotropic signal level of –80 dBm_I.

Figures 2.1-2 displays the spectrum photograph of the described calibration procedure employed during these measurements.

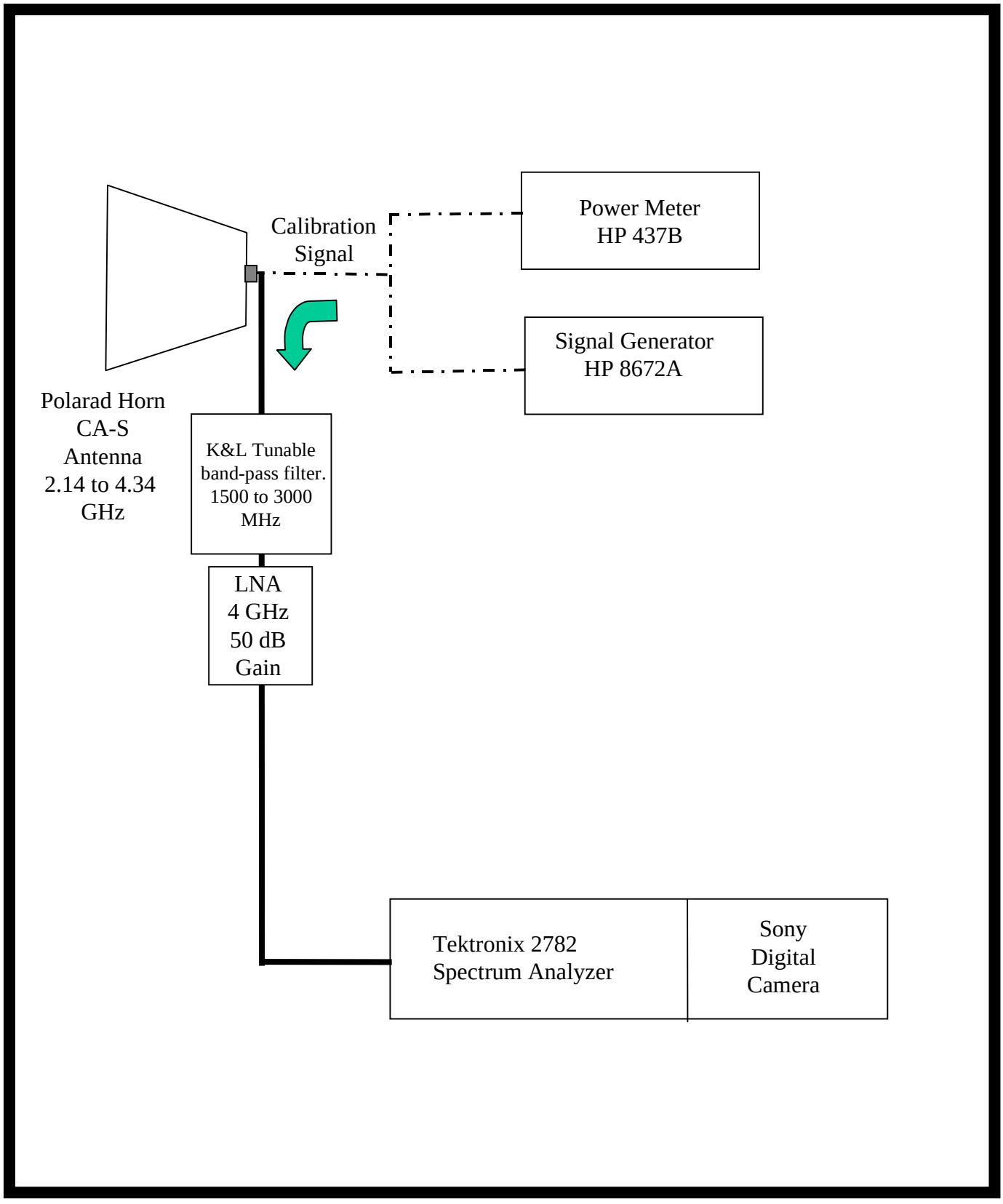


Figure 2.1-1 Receive Test Equipment Block Diagram

COMSEARCH

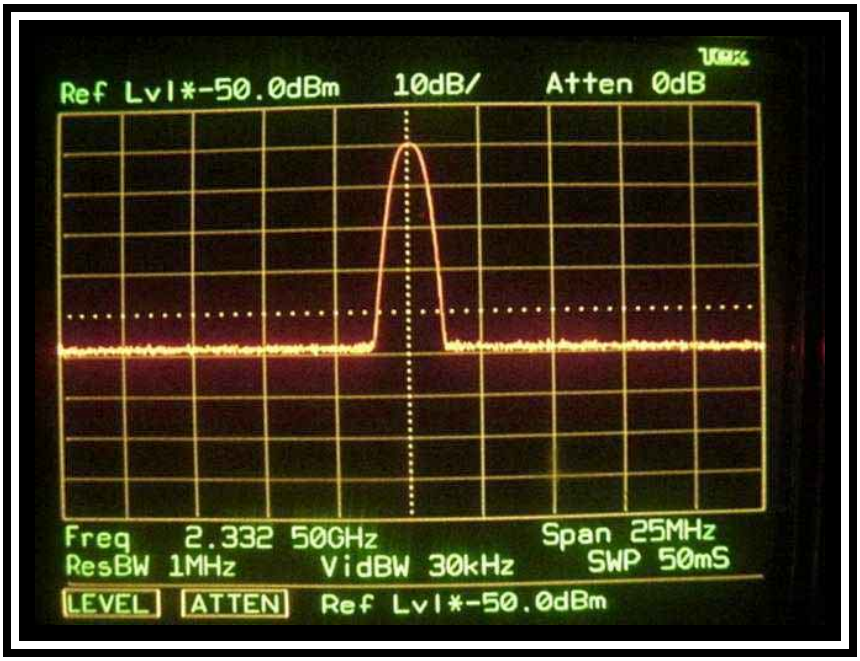
Multiple Measurements – Northern Virginia

Reference Level dBm_I

Calibration Photograph

XM Satellite Radio

-70



Date: October, 2000
Center Freq: 2332.5 MHz
Span/Div: 2.5 MHz
Res. Bandwidth: 1 MHz
Amplitude/Div: 10 dB

-60 dBm, 2332.5 MHz signal indication on the spectrum photograph represents a –60 dBm signal being injected at the point where the test cable connects to the output of the test antenna.

Displayed Reference Level equals:

-60 dBm injected signal
<u>-20 dB antenna gain</u>
-80 dBm_I Therefore, a displayed signal level of –50 dBm equals a –70 dBm_I isotropic level when using the Polarad CA-5 test antenna.
Noise floor at –130 dBm in a 1 MHz Band width.

Figure 2.1-2 RF Calibration Photograph

2.2 Methodology

Upon arriving at each testing location, site coordinates were obtained using a GPS unit and the site location was plotted on a map. All coordinates were obtained using a GPS unit and are based on NAD 83 datum. In addition, site photographs were taken to visually document the measurement location. All compass readings are in Magnetic North headings. This resulting location information is presented for each site in the Data Presentation (Section 3) portion of this report.

After each sites coordinates and location photograph's were documented, the test equipment was set up and calibrated, as outlined in Section 2.1, to measure the RF environment. Measurements were conducted at each test site in the frequency range of interest from 2320 to 2345 MHz. After the equipment calibration was completed, the test antenna was mounted on a tripod at a height of five (5) feet. As specified by XM Satellite Radio, this height was standardized for all measurement locations. Five (5) feet was used as this is the equivalent of the height above ground of XM Satellite Radio vehicle antenna reception.

Initially, the test antenna was rotated 360 degrees (scanning), once in each polarization, while activating the peak hold function of the spectrum analyzer. This enabled the analyzer to maintain and display the maximum signal level received for all frequencies under consideration. After the initial recording of the 360-degree scans, the maximum amplitude of all individually observed signals in the measurement band was determined as to their frequency, azimuth and received level. The results of these measurements for each location are presented in Section 4 of this report.

SECTION

THREE

SECTION 3

DATA PRESENTATION

This section contains site descriptions, maps, and site and spectrum photographs pertaining to each of the locations measured.

For each measurement location, the frequency range was set to observe the full DARS band from 2320 – 2345 MHz. This places XM Satellite Radio's 12.5 MHz band (2332.5 – 2345.0 MHz) in the upper-half of the spectrum analyzer photographs and the Sirius Satellite Radio band in the lower-half (2320.0 – 2332.5 MHz) of the spectrum analyzer photographs. Although the full DARS band was measured, data presented in this report is confined to XM Satellite Radio upper 12.5 MHz.

As evident in the spectrum photographs, signals were observed at various locations at 2336 and 2339 MHz, which fall within the XM Satellite Radio band. These constant wave (CW) signals were being generated by LCC as part of their drive testing responsibilities for engineering the terrestrial portion of the XM Satellite Radio network. As these signals were being generated as part of the network testing and will not in themselves cause interference to XM Satellite Radio reception, the effect of theses measured signals are not considered in the results of this report. Although the LCC testing signals are identified in each spectrum photograph, the pertinent information provided in each spectrum photograph involves the levels of other measured signals within the 12.5 MHz band of interest.

Following this section, the summary of results for all in-band measurements is presented in Section 4 of this report.

Section 3 Index

Specific sections for each measurement location are as follows:

SECTION 3.1

Baileys Crossroads, VA

SECTION 3

DATA PRESENTATION

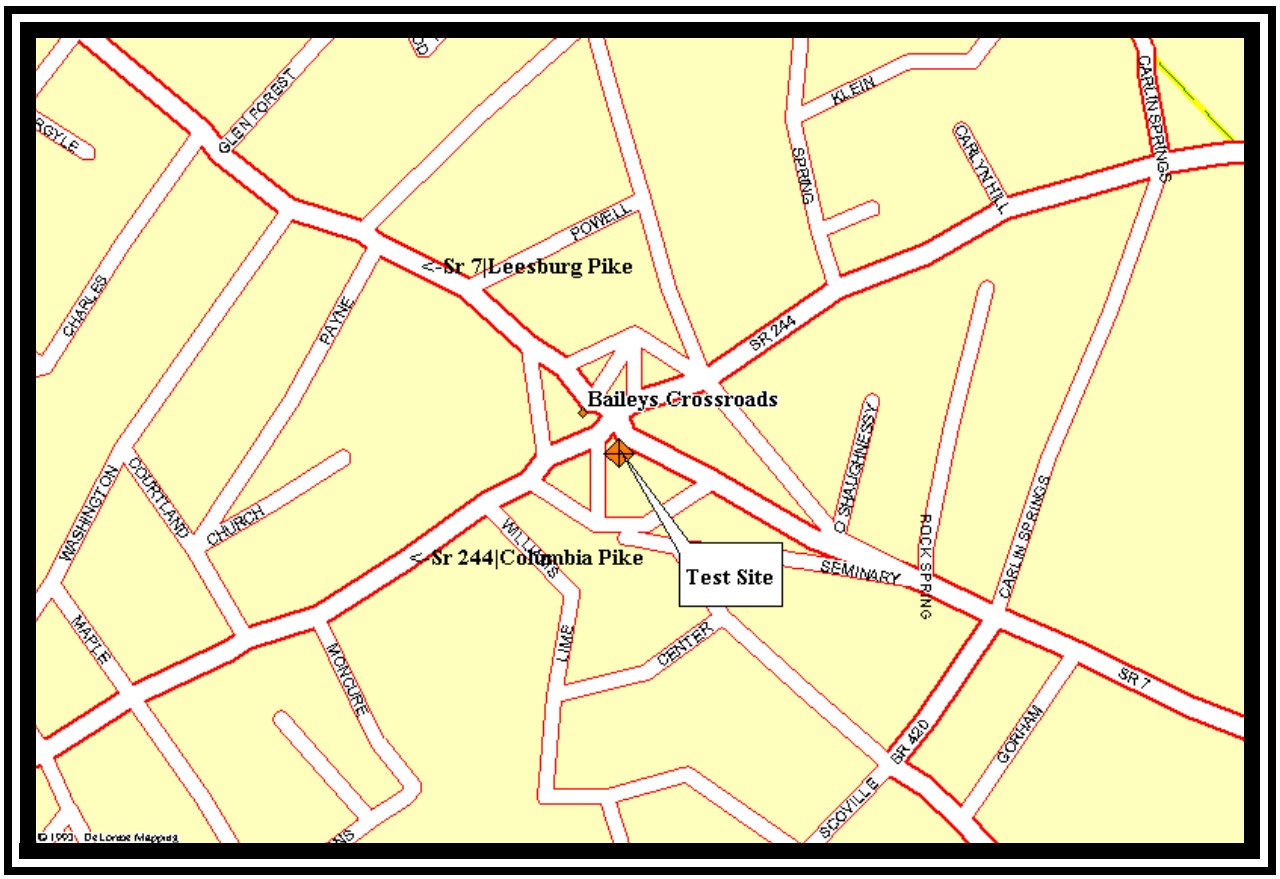
The following section contains the site descriptions, maps, and site photographs and spectrum photographs pertaining to the location measured.

3.1 Baileys Crossroads, Virginia - Intersection of Route 7 and Columbia Pike

- Figure 3.1-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.1-2 is the photograph depicting the test site.

- Figures 3.1-3 through 3.1-7 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Intersection of Columbia Pike and Route 7, **Baileys Crossroads**, Virginia

Type Environment: City, Busy Road, Overpass

GPS Coordinates (NAD 83): 38 50 58.5 N
77 07 43.6 W

Date/Time of Measurement: October 11, 2000/ 11:20 AM to 12:40 PM
October 16, 2000/ 14:00 PM to 14:35 PM

Figure 3.1-1 Measurement Site Date Sheet

Measurment Site Photo: Baileys Crossroads, Virginia

Figure 3.1-1 (cont.) Measurement Site Date Sheet

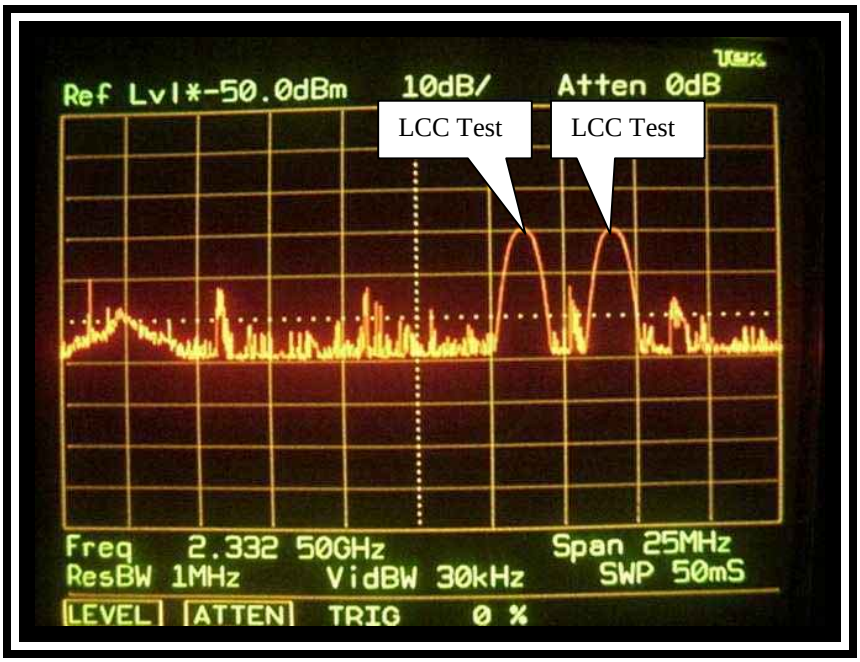
Baileys Crossroads, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



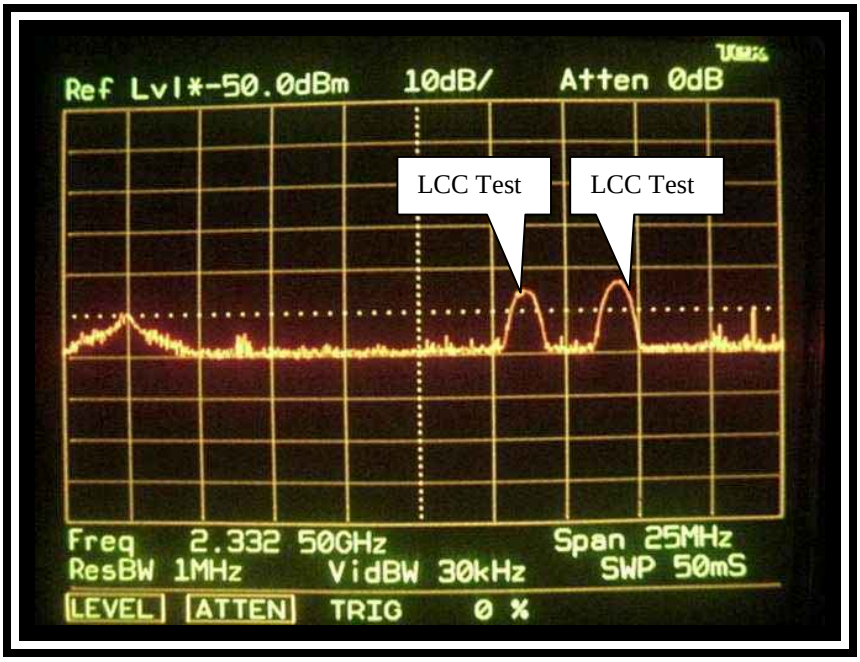
Date: October 10, 2000
Time of Day: 11:54
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 11:56
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.1-3 RF Spectrum Analysis

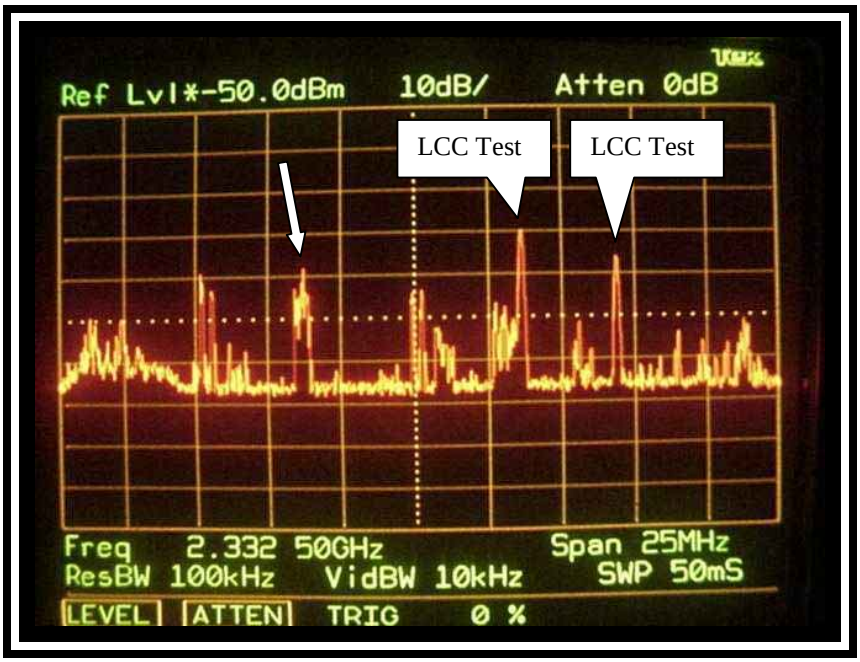
Baileys Crossroads, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 12:02
Ant. Polarization: V

Full Antenna Sweep

100 kHz Resolution Bandwidth

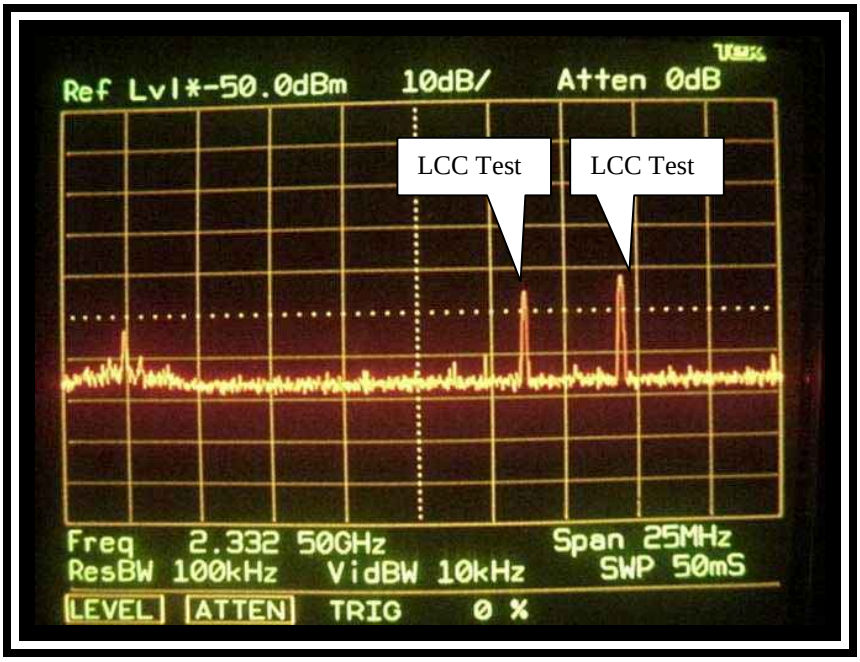
Traffic passing within 25 feet of the test antenna.

Maximum ignition noise interference signal measured was –108 dBm at 2328.75 MHz.

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 11:59
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

(B)

Figure 3.1-4 RF Spectrum Analysis

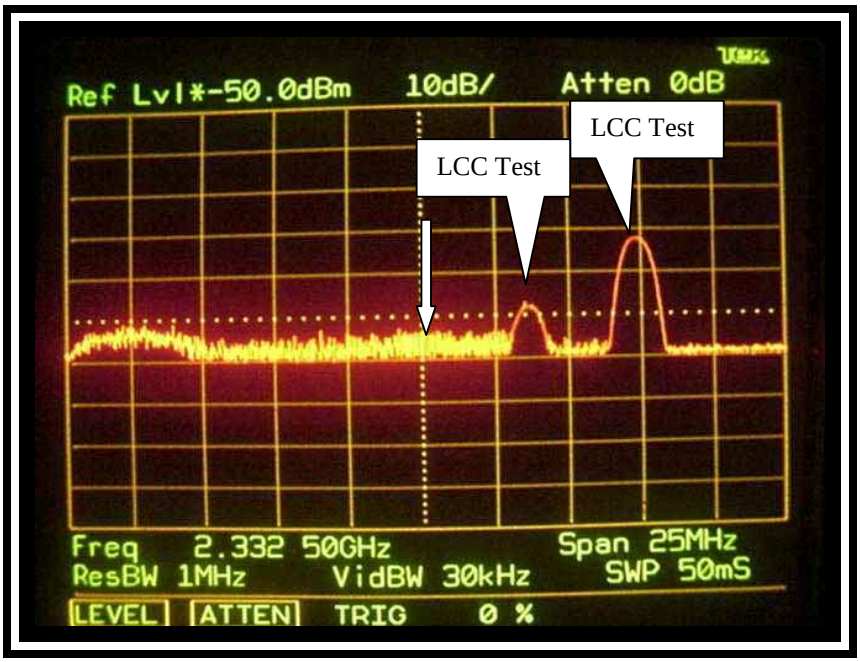
Baileys Crossroads, Virginia

Reference Level dBm_I

Azimuth 181°/Elevation 4°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 12:32
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_I)
2332.5	**-124.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

(A)

Photograph shows the direction of vehicle ignition noise measured above.

(B)

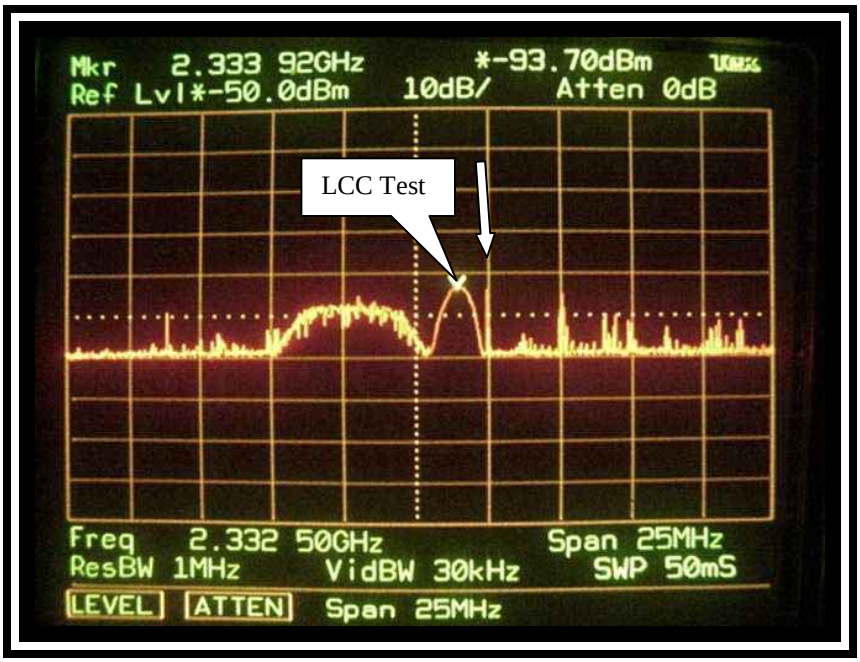
Figure 3.1-5 RF Spectrum Analysis

Baileys Crossroads, Virginia

Reference Level dBm_I — Azimuth 235°/Elevation 2°

XM Satellite Radio

-70



(A)

Date: October 16, 2000
Time of Day: 14:25
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_I)
2334	**-114.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

(B)

Photograph shows the direction of vehicle ignition noise measured above.

Figure 3.1-6 RF Spectrum Analysis

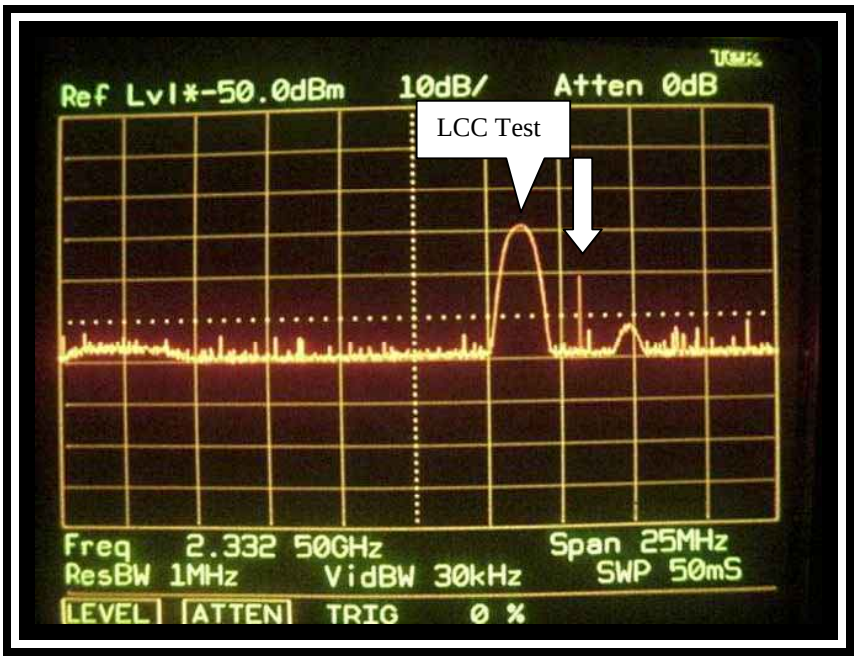
Baileys Crossroads, Virginia

Reference Level dBm_I

Azimuth 326°/Elevation 5°

XM Satellite Radio

-70



(A)

Date: October 10, 2000
Time of Day: 12:27
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_I)
2338.1	**-110.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

(B)

Photograph shows the direction of vehicle ignition noise measured above.

Figure 3.1-7 RF Spectrum Analysis

SECTION 3.2

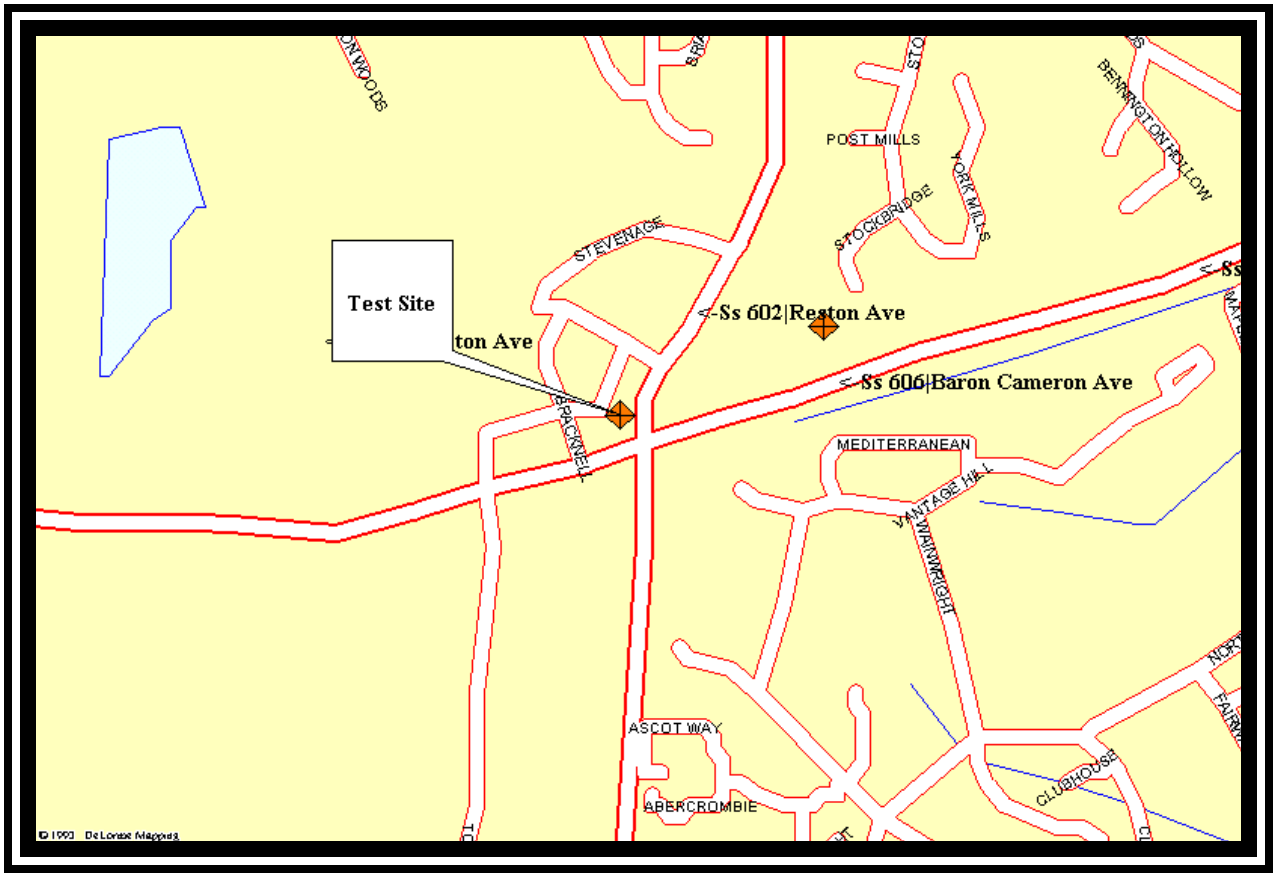
Reston, VA

3.2 Reston, Virginia - Hechinger Parking Lot at the intersection of Baron Cameron Avenue and Reston Parkway

- Figure 3.2-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.2-2 is the photograph depicting the test site.

- Figure 3.2-3 is the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Hechinger Parking Lot off of Reston Parkway and Baron Cameron, Reston, Virginia

Type Environment: Suburban, Busy Road, Store Parking Lot

GPS Coordinates (NAD 83): 38 58 04.9 N
77 21 17.6 W

Date/Time of Measurement: October 9, 2000/ 15:15 PM to 16:00 PM

Figure 3.2-1 Measurement Site Date Sheet

Hechinger Parking Lot off of Reston Parkway and Baron Cameron, Reston, Virginia.

Figure 3.2-2 Measurement Site Photograph

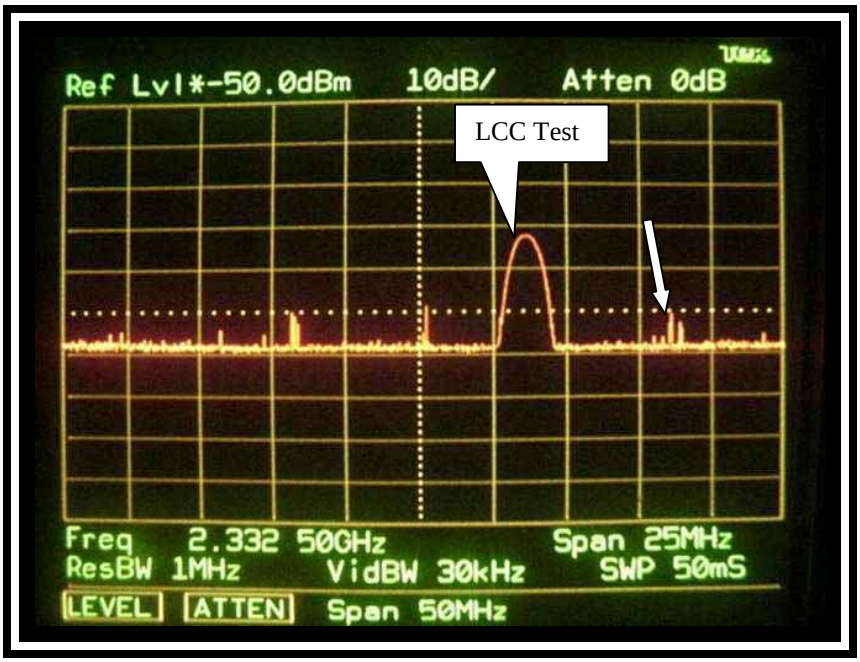
Hechinger Parking lot, Reston, Virginia

Reference Level dBm_I

Azimuth 125°/Elevation 10°

XM Satellite Radio

-70



(A)

Date: October 9, 2000
Time of Day: 15:48
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_I)
2341	**-120.0***

*** Maximum vehicle ignition noise measured as indicated by arrow.**

Figure 3.2-3 RF Spectrum Analysis

SECTION 3.3

Vienna, VA

3.3 Vienna, Virginia - Cul-De-Sac of Surveyor Court off of Pleasant Road

- Figure 3.3-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.3-2 is the photographs depicting the test site.

- Figures 3.3-3 through 3.4-5 are the RF spectrum photographs depicting the interference environment at the test site.

Site Location: Cal-De-Sac of Surveyor Court off of Pleasant Road in Vienna, Virginia

Type Environment: Residential

GPS Coordinates (NAD 83): 38 53 47.1 N
77 16 03.7 W

Date/Time of Measurement: October 10, 2000/ 11:20 AM to 12:40 PM

Engineering Comments: Frequency 2342 MHz appears to be coming from a home protection system (Brinks). The main controls for this system appears to be coming from the garage.

Figure 3.3-1 Measurement Site Date Sheet

Cul-De-Sac of Surveyor Court off of Pleasant Road in Vienna, Virginia

Figure 3.3-2 Test Measurement Site Photographs

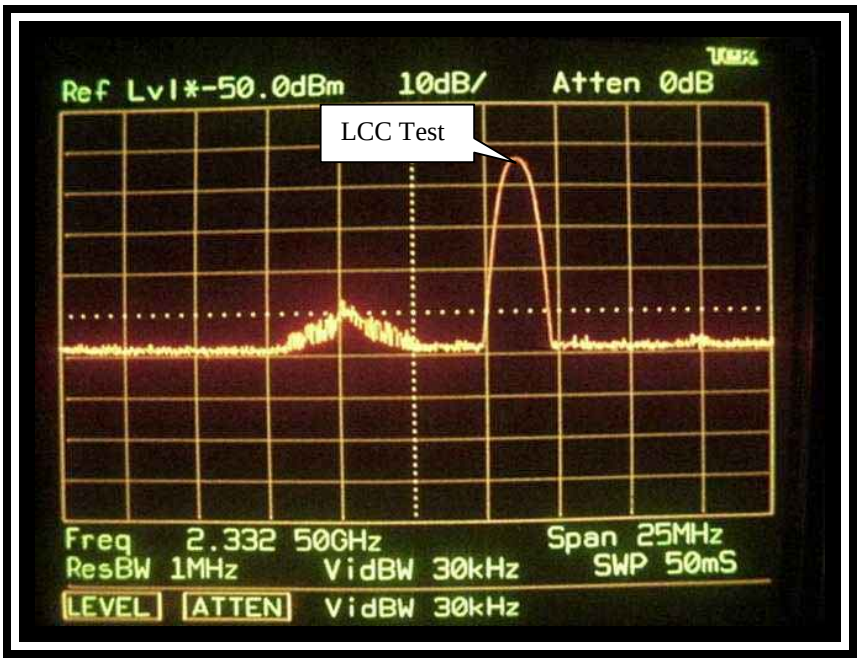
Surveyor Court - Vienna, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



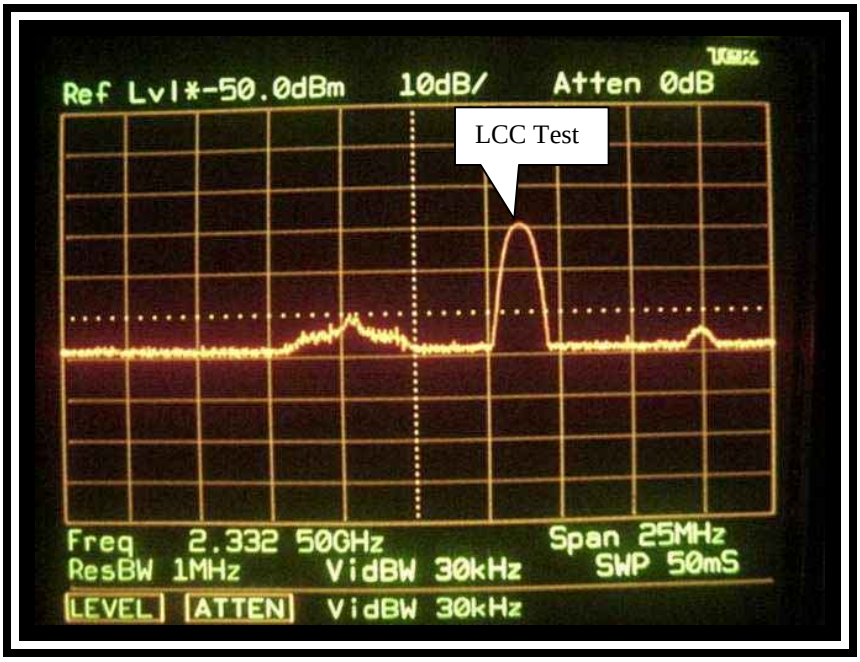
Date: October 10, 2000
Time of Day: 12:02
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 12:07
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.3-3 RF Spectrum Analysis

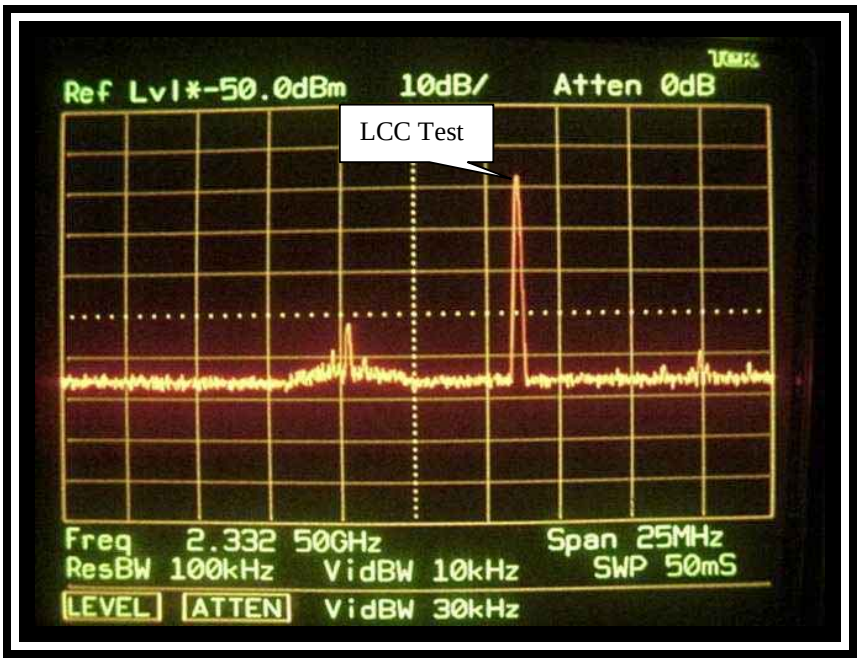
Surveyor Court - Vienna, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 12:10
Ant. Polarization: V
Ant. Centerline: 5 Ft.

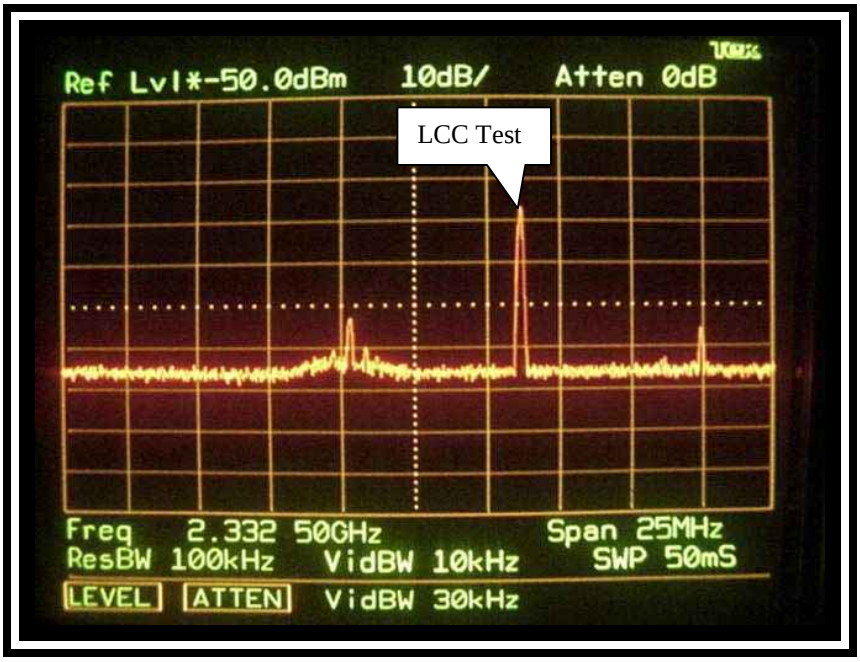
Full Antenna Sweep

100 kHz Resolution Bandwidth

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 12:09
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

(B)

Figure 3.3-4 RF Spectrum Analysis

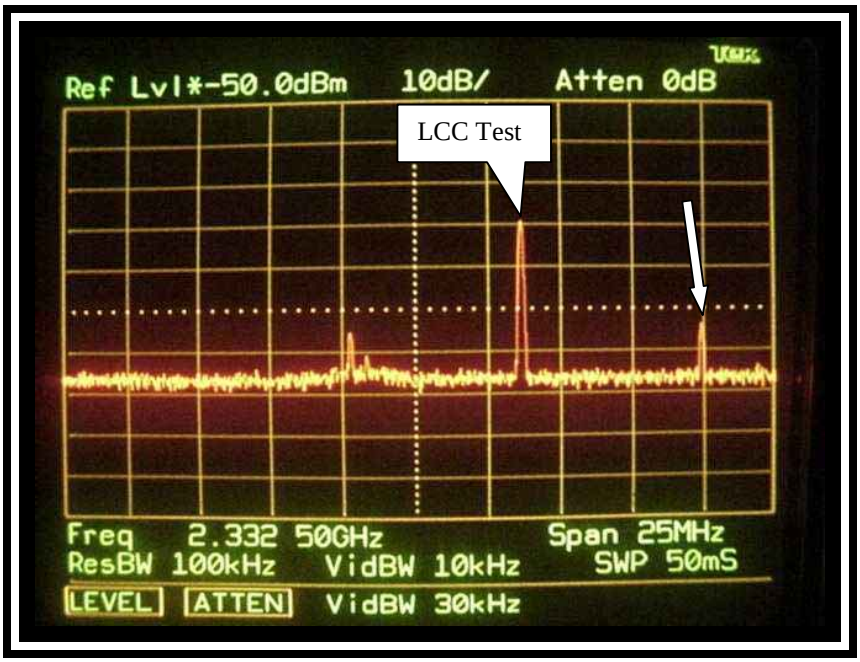
Surveyor Court - Vienna, Virginia

Reference Level dBm_I

Azimuth 169°/Elevation -5°

XM Satellite Radio

-70



(A)

Date: October 10, 2000
Time of Day: 12:16
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Test antenna is peaked on 2342 MHz interference signal, both in azimuth and elevation.

Highest Recorded Signal:

MHz	Level (dBm_I)
2342	**-124.6**

(B)

Photograph shows the direction of interference at 2342 MHz.

Sign posted in front yard that the home is protected by "BRINKS".

Figure 3.3-5 RF Spectrum Analysis

SECTION 3.4

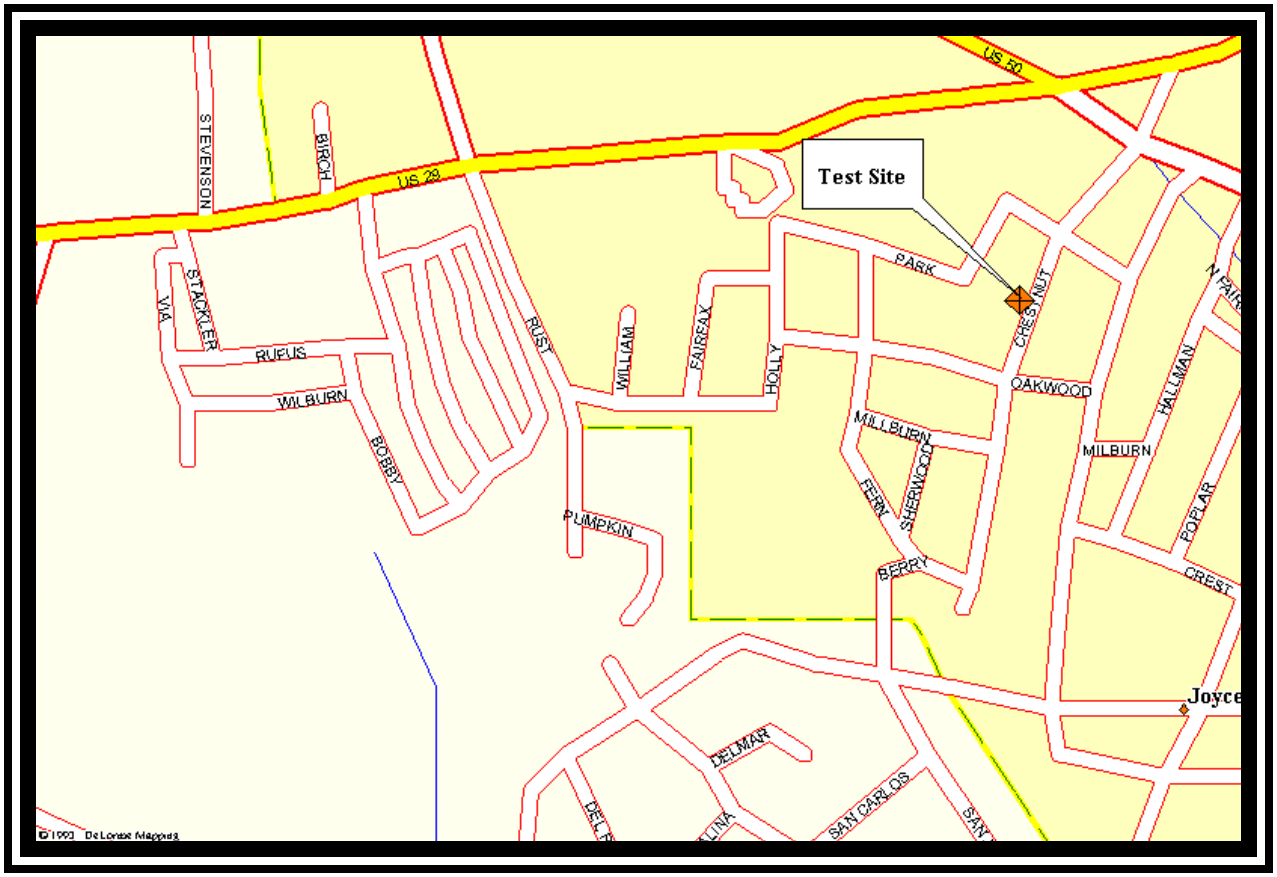
Fairfax, VA

3.4 Fairfax, Virginia - Intersection of Chestnut Street and Park Road

- Figure 3.4-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.4-2 is the photographs depicting the test site.

- Figures 3.4-3 through 3.4-4 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Intersection of Chestnut St. and Park Road in Fairfax, Virginia

Type Environment: Residential community, no major traffic,

GPS Coordinates (NAD 83): 38 51 01.3 N
77 19 26.3 W

Date/Time of Measurement: October 10, 2000/ 4:30 PM to 5:00 PM

Figure 3.4-1 Measurement Site Date Sheet

Intersection of Chestnut Street and Park Road in Fairfax, Virginia

Figure 3.4-2 Test Measurement Site Photographs

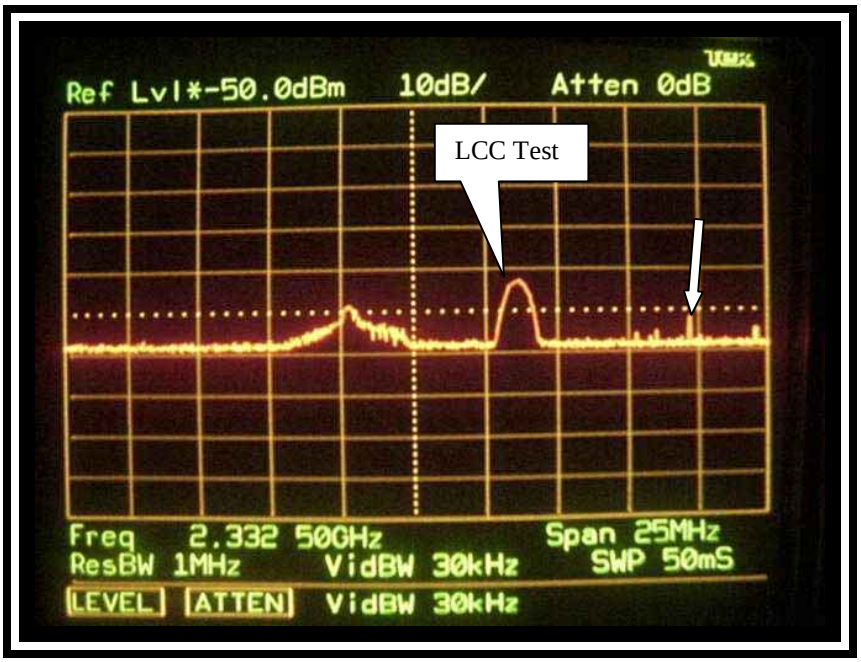
Chestnut and Park - Vienna, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 16:37
Ant. Polarization: V
Ant. Centerline: 5 Ft.

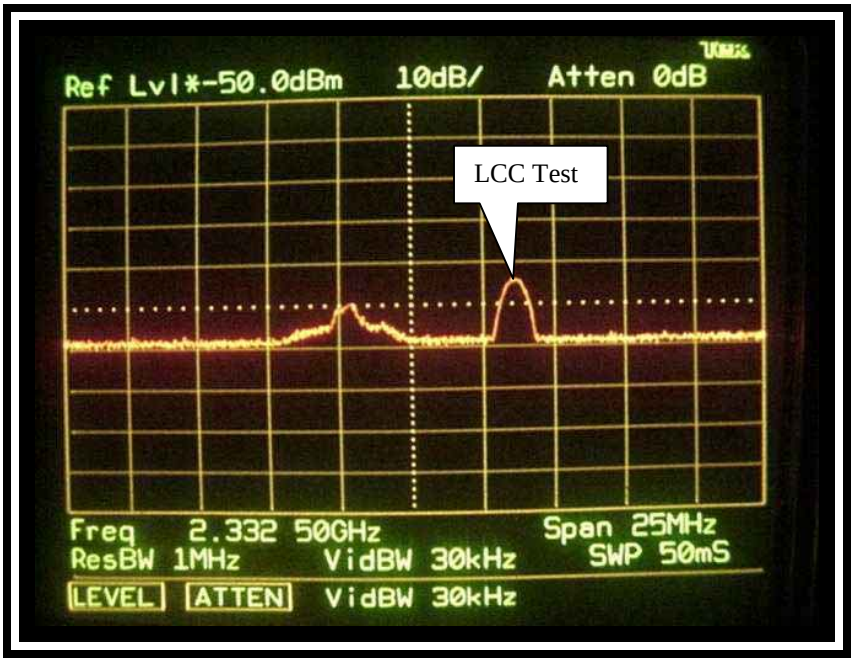
Full Antenna Sweep

Maximum ignition noise interference signal measured was –122 dBm at 2342.25 MHz as indicated by arrow.

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 16:39
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.4-3 RF Spectrum Analysis

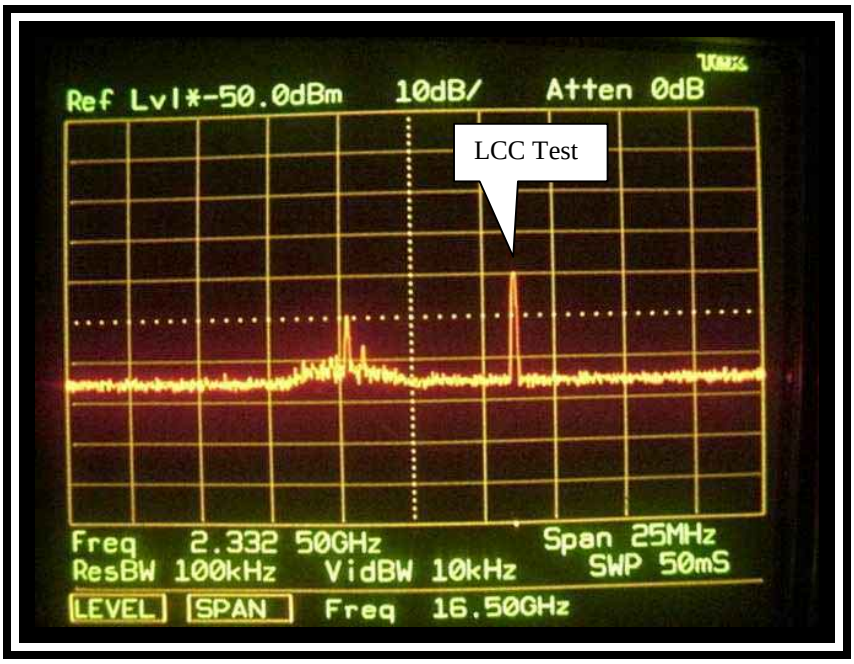
Chestnut and Park - Vienna, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 16:43
Ant. Polarization: V
Ant. Centerline: 5 Ft.

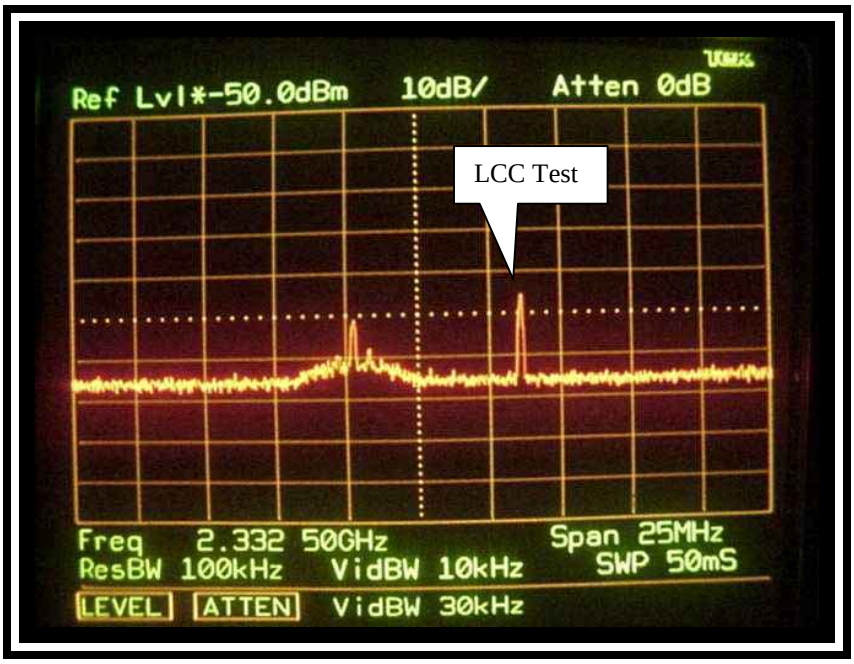
Full Antenna Sweep

100 kHz Resolution Bandwidth

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 16:40
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

(B)

Figure 3.4-4 RF Spectrum Analysis

SECTION 3.5

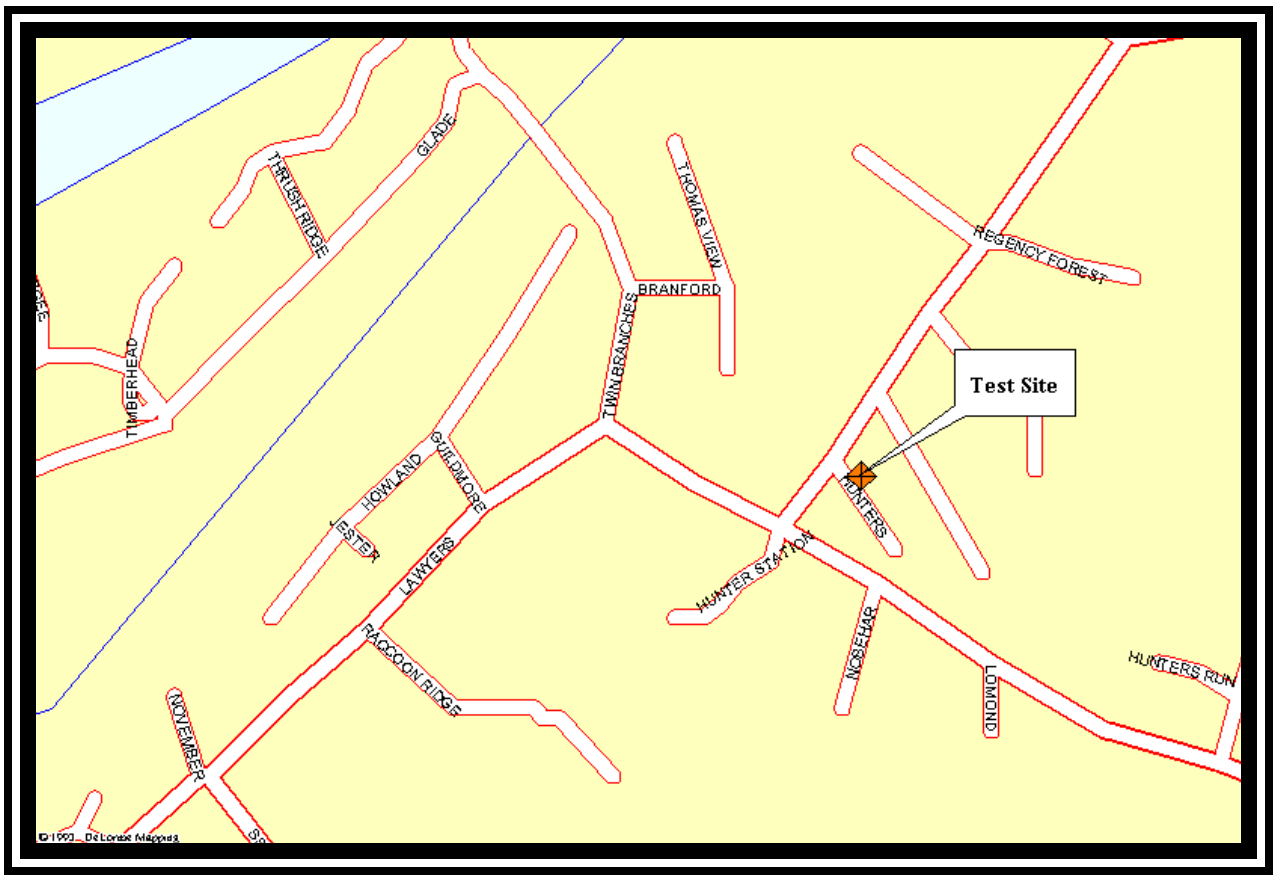
Reston, VA

3.5 Reston, Virginia – 119 Feet SE of Intersection of Hunter Station and Hunters Place

- Figure 3.5-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.5-2 is the photograph depicting the test site.

- Figure 3.5-3 is the RF spectrum photographs depicting the interference environment at the test site.



Site Location: 119 feet SE of intersection of Hunter Station and Hunters Place in Reston, Virginia

Type Environment: Residential community, no major traffic,

GPS Coordinates (NAD 83): 38 55 39.2 N
77 19 09.5 W

Date/Time of Measurement: October 10, 2000/ 11:15 AM to 11:30 PM

Figure 3.5-1 Measurement Site Date Sheet

119 feet SE of intersection of Hunter Station and Hunters Place in Reston, Virginia

Figure 3.5-2 Test Measurement Site Photographs

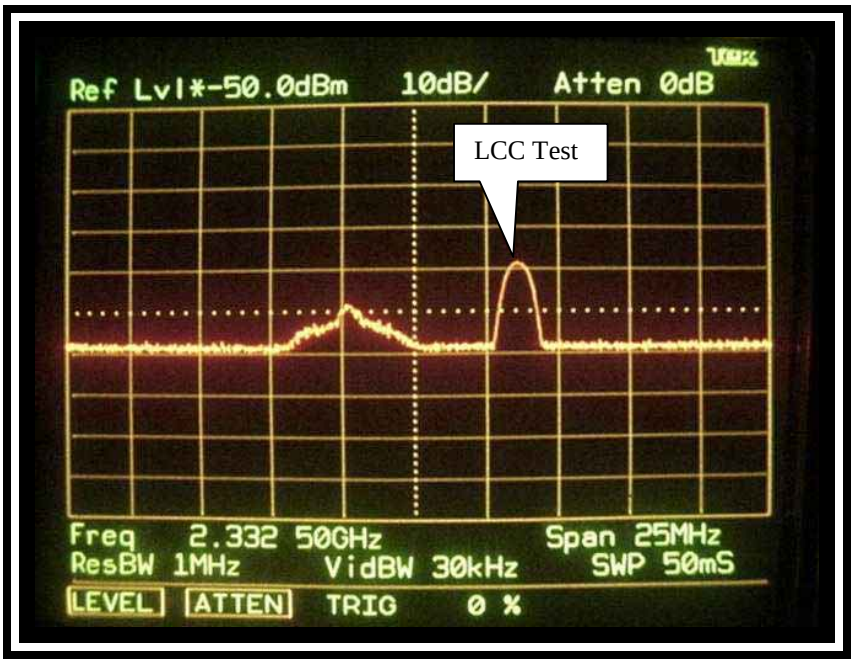
Hunters Place - Reston, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



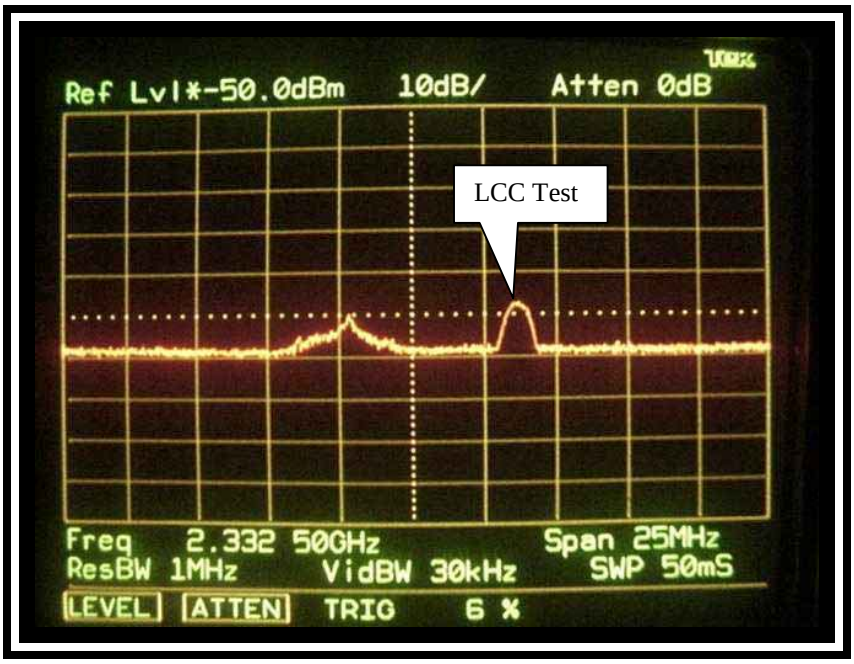
Date: October 10, 2000
Time of Day: 11:28
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 11:30
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.5-3 RF Spectrum Analysis

SECTION 3.6

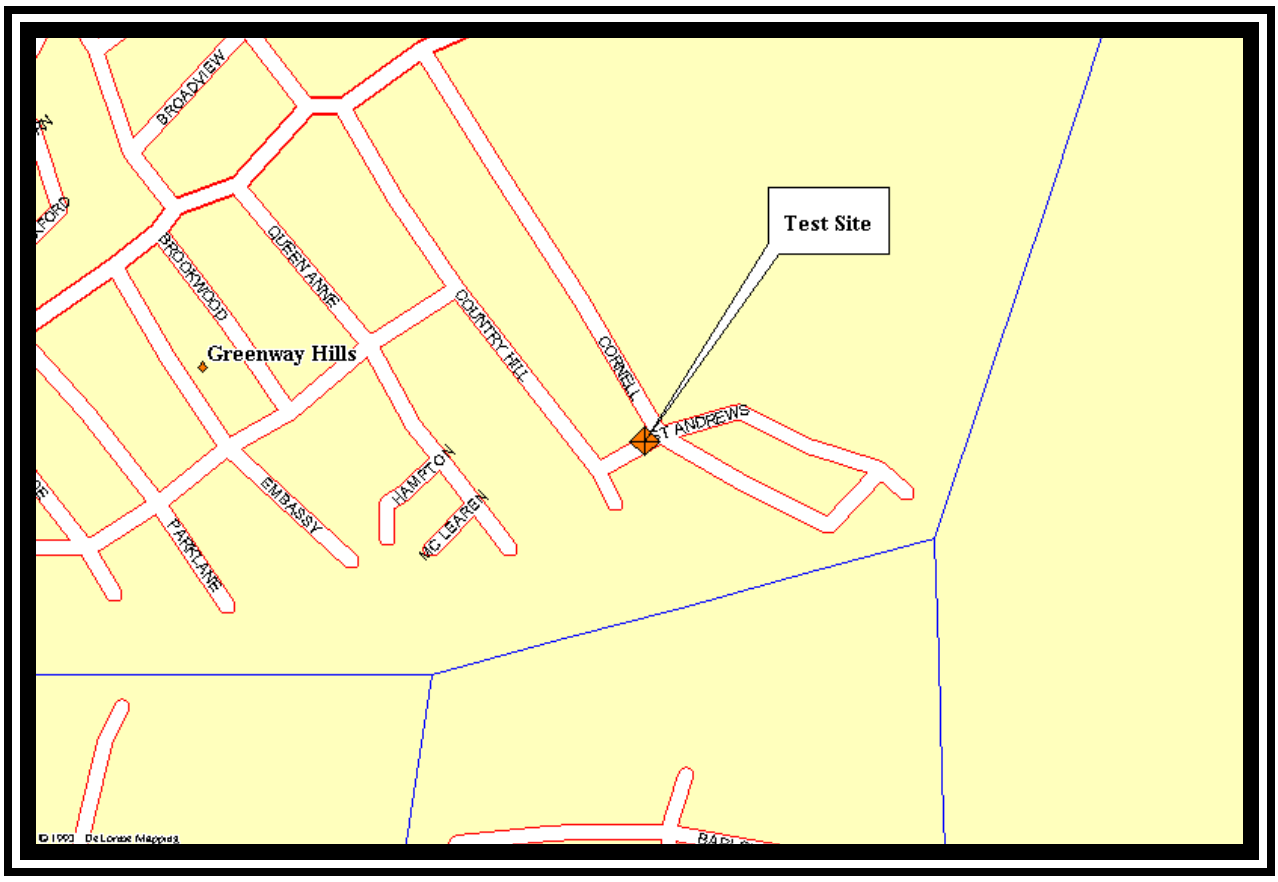
Fairfax, VA

3.6 Fairfax, Virginia – Intersection of St. Andrews and Connell Road

- Figure 3.6-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.6-2 is the photograph depicting the test site.

- Figures 3.6-3 through 3.6-4 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Intersection of St. Andrews and Connell Road Fairfax, Virginia

Type Environment: Residential

GPS Coordinates (NAD 83): 38 51 15.0 N
77 16 59.5 W

Date/Time of Measurement: October 10, 2000/ 5:15 PM to 5:40 PM

Figure 3.6-1 Measurement Site Date Sheet

Intersection of St. Andrews and Connell Road Fairfax, Virginia

Figure 3.6-2 Test Measurement Site Photographs

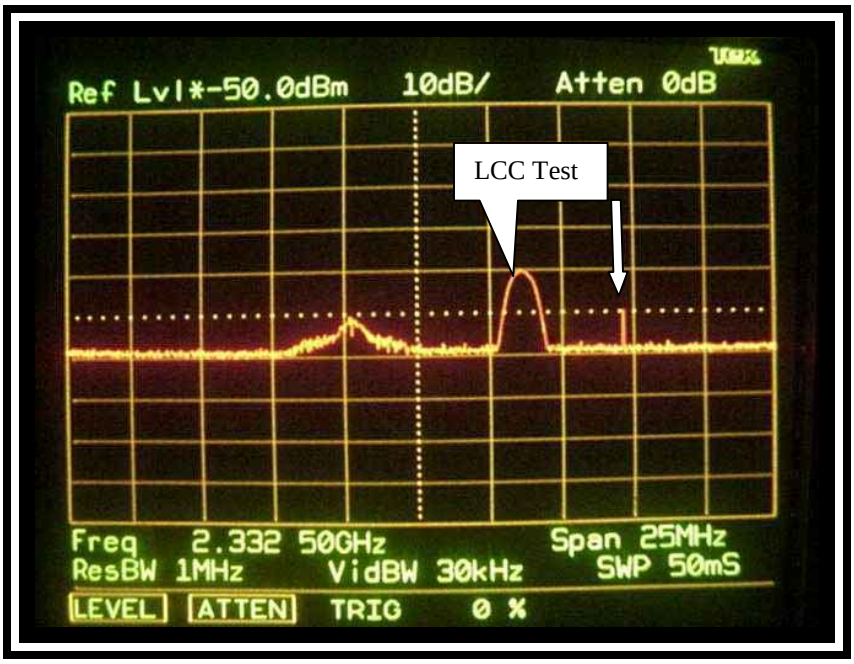
St. Andrews and Connell - Fairfax, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 17:26
Ant. Polarization: V
Ant. Centerline: 5 Ft.

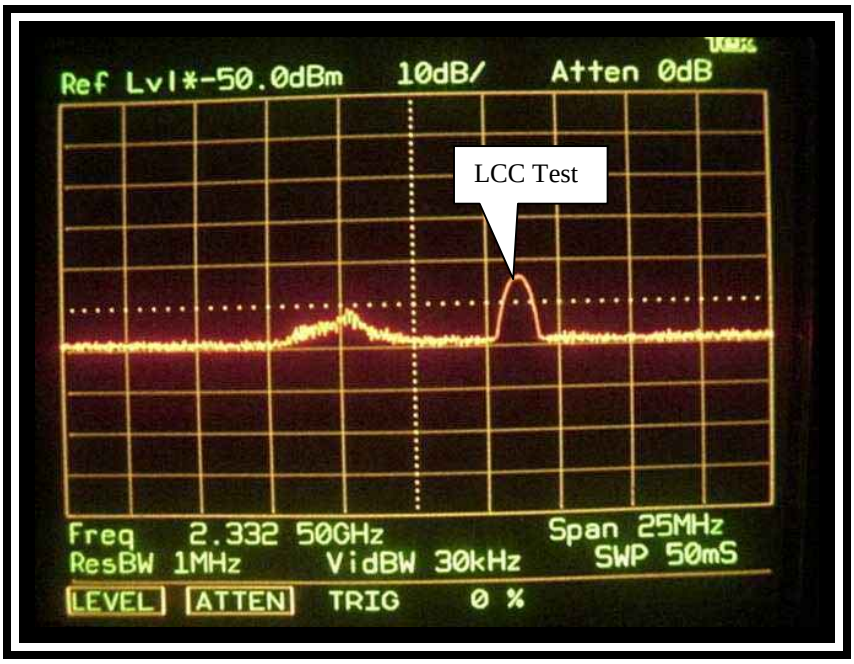
Full Antenna Sweep

Maximum ignition noise interference signal measured was –120 dBm at 2339.5 MHz as indicated by arrow.

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 17:27
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.6-3 RF Spectrum Analysis

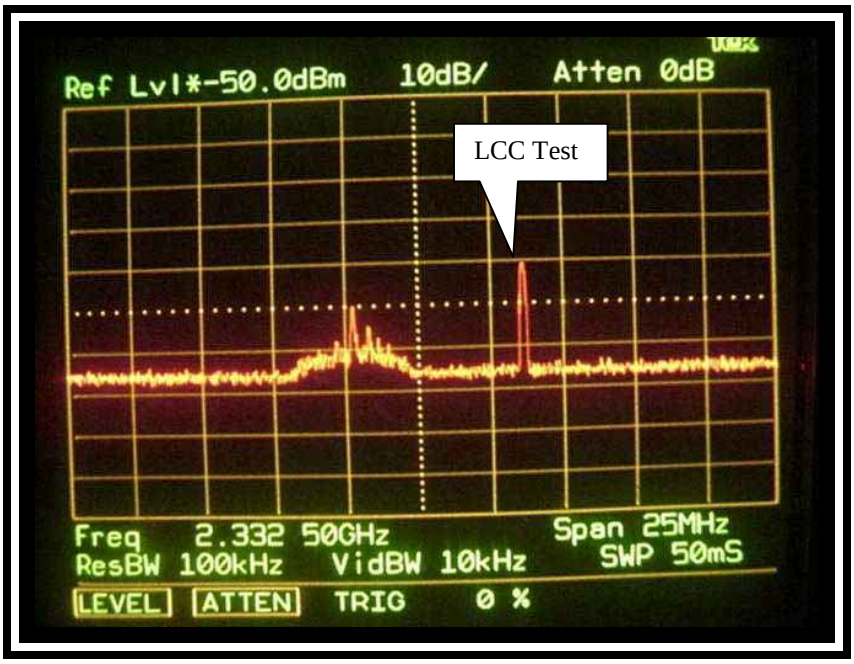
St. Andrews and Connell - Fairfax, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 10, 2000
Time of Day: 17:31
Ant. Polarization: V
Ant. Centerline: 5 Ft.

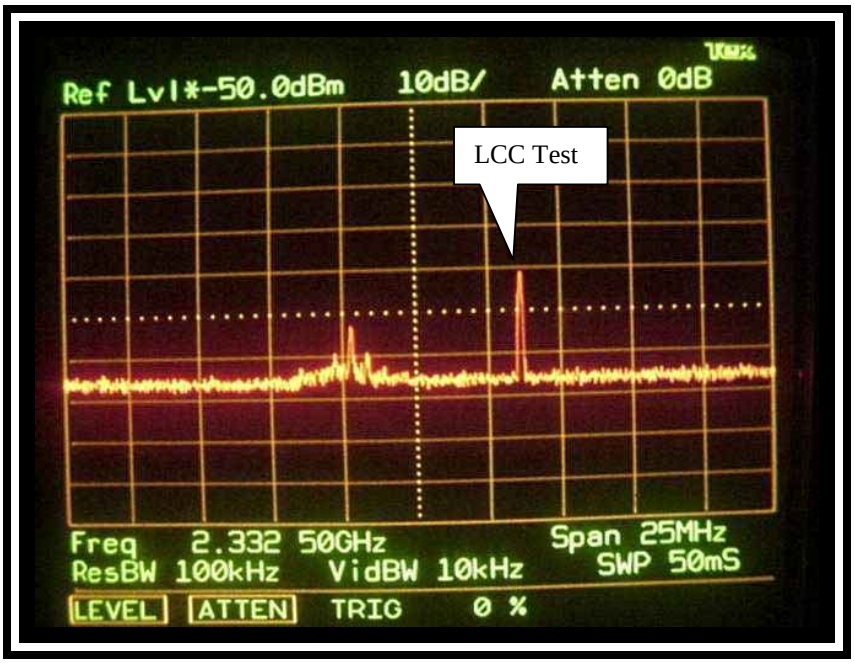
Full Antenna Sweep

100 kHz Resolution Bandwidth

(A)

Reference Level dBm_I

-70



Date: October 10, 2000
Time of Day: 17:29
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

(B)

Figure 3.6-4 RF Spectrum Analysis

SECTION 3.7

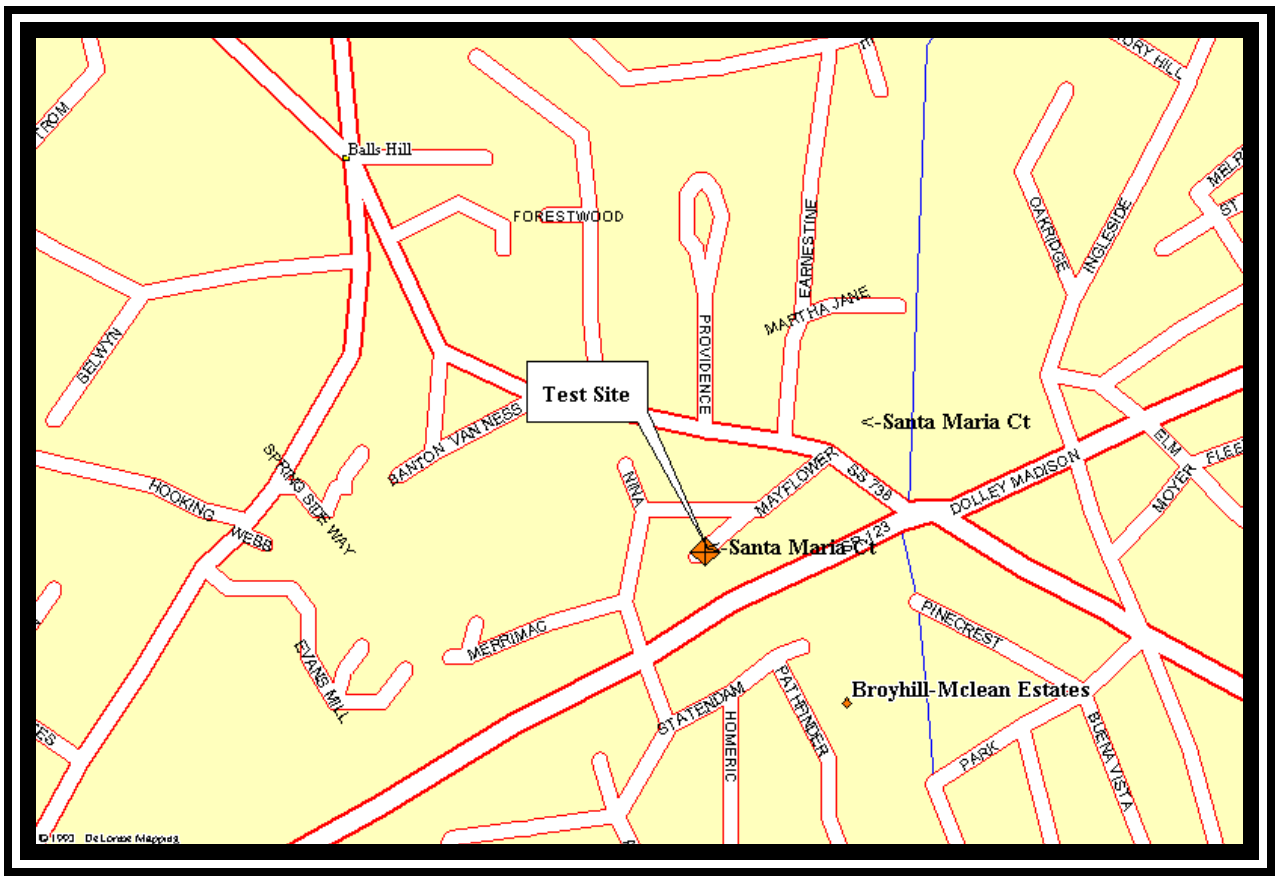
McLean, VA

3.7 McLean, Virginia – Cul-De-Sac of Santa Maria Court off of Mayflower Drive

- Figure 3.7-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.7-2 is the photograph depicting the test site.

- Figures 3.7-3 through 3.7-4 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Cul-De-Sac of Santa Maria Court off of Mayflower Drive in McLean,Virginia

Type Environment: Residential

GPS Coordinates (NAD 83): 38 56 02.9 N
77 11 24.1 W

Date/Time of Measurement: October 11, 2000/ 10:00 AM to 11:00 AM

Figure 3.7-1 Measurement Site Date Sheet

: Cul-De-Sac of Santa Maria Court off of Mayflower Drive in McLean,Virginia

Figure 3.7-2 Test Measurement Site Photographs

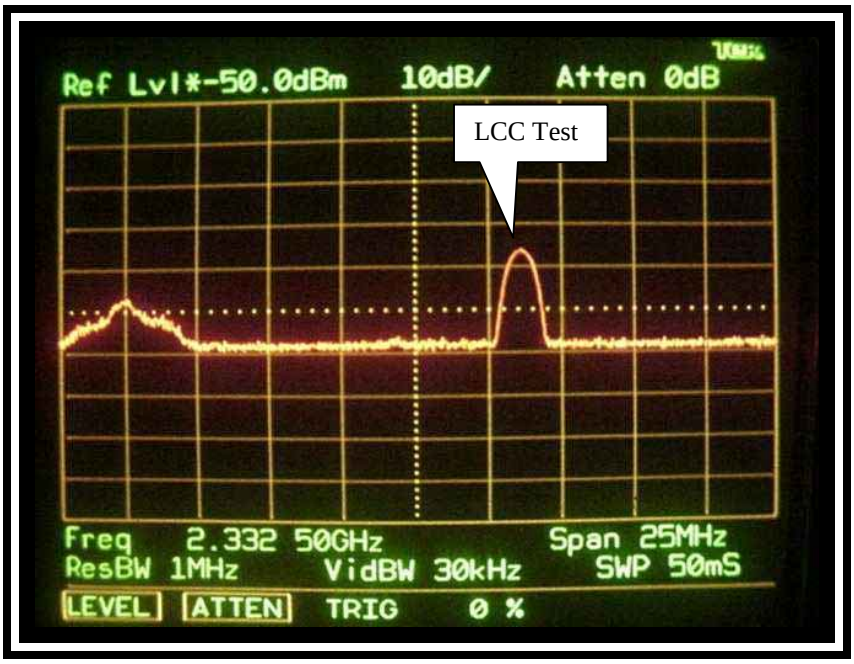
Santa Maria Court - McLean, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



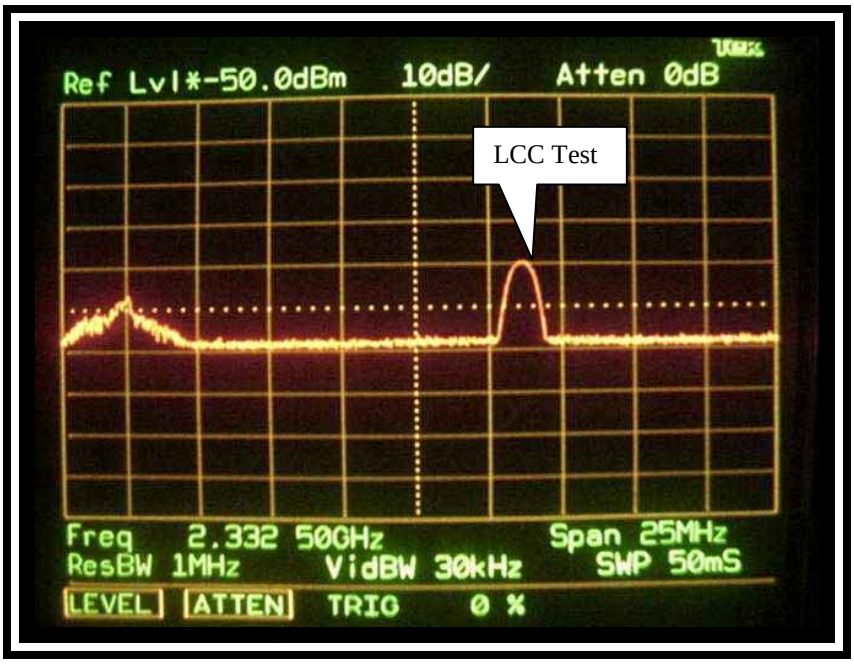
Date: October 11, 2000
Time of Day: 10:37
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference Level dBm_I

-70



Date: October 11, 2000
Time of Day: 10:39
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(B)

Figure 3.7-3 RF Spectrum Analysis

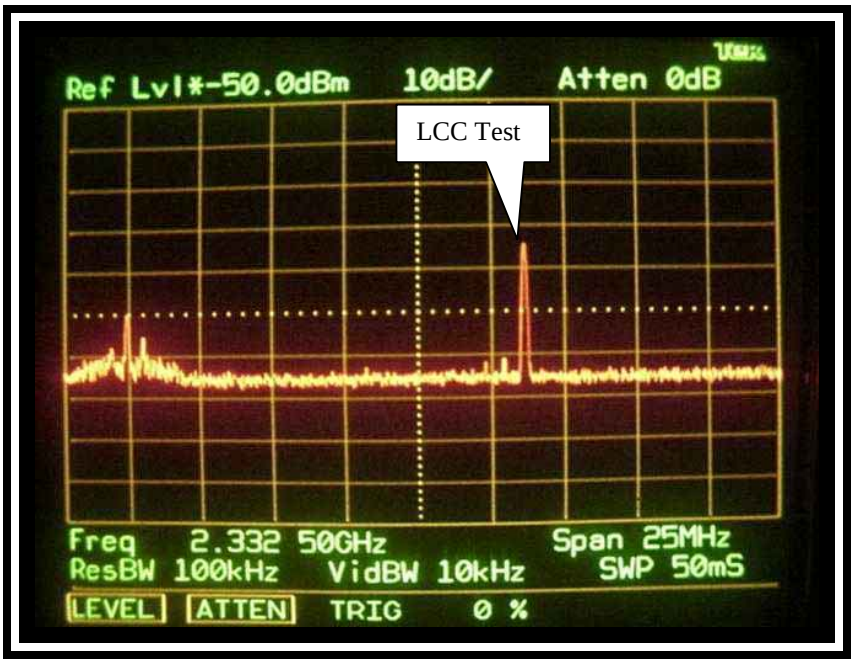
Santa Maria Court - McLean, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 11, 2000
Time of Day: 10:43
Ant. Polarization: V
Ant. Centerline: 5 Ft.

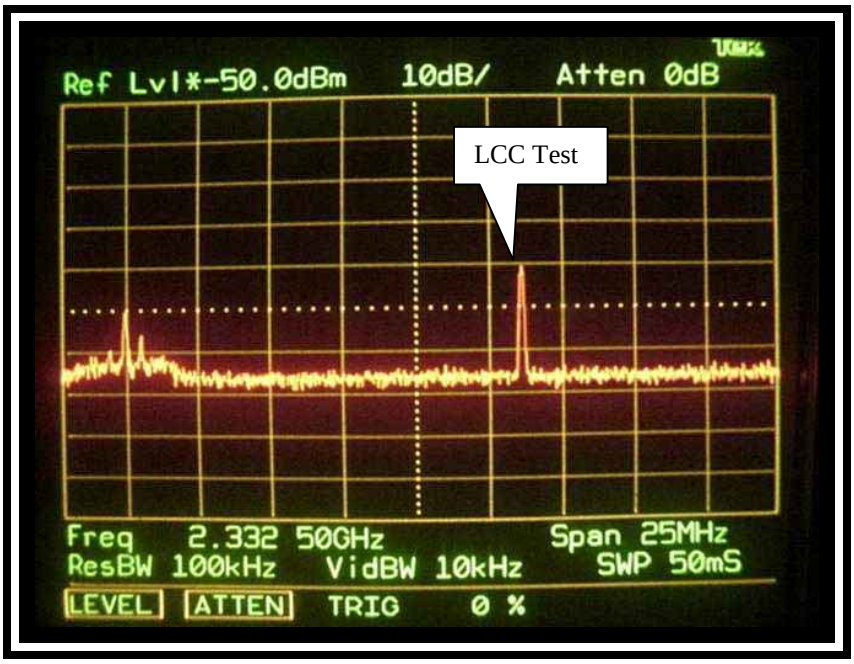
Full Antenna Sweep

100 kHz Resolution Bandwidth

(A)

Reference Level dBm_I

-70



Date: October 11, 2000
Time of Day: 10:41
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

(B)

Figure 3.7-4 RF Spectrum Analysis

SECTION 3.8

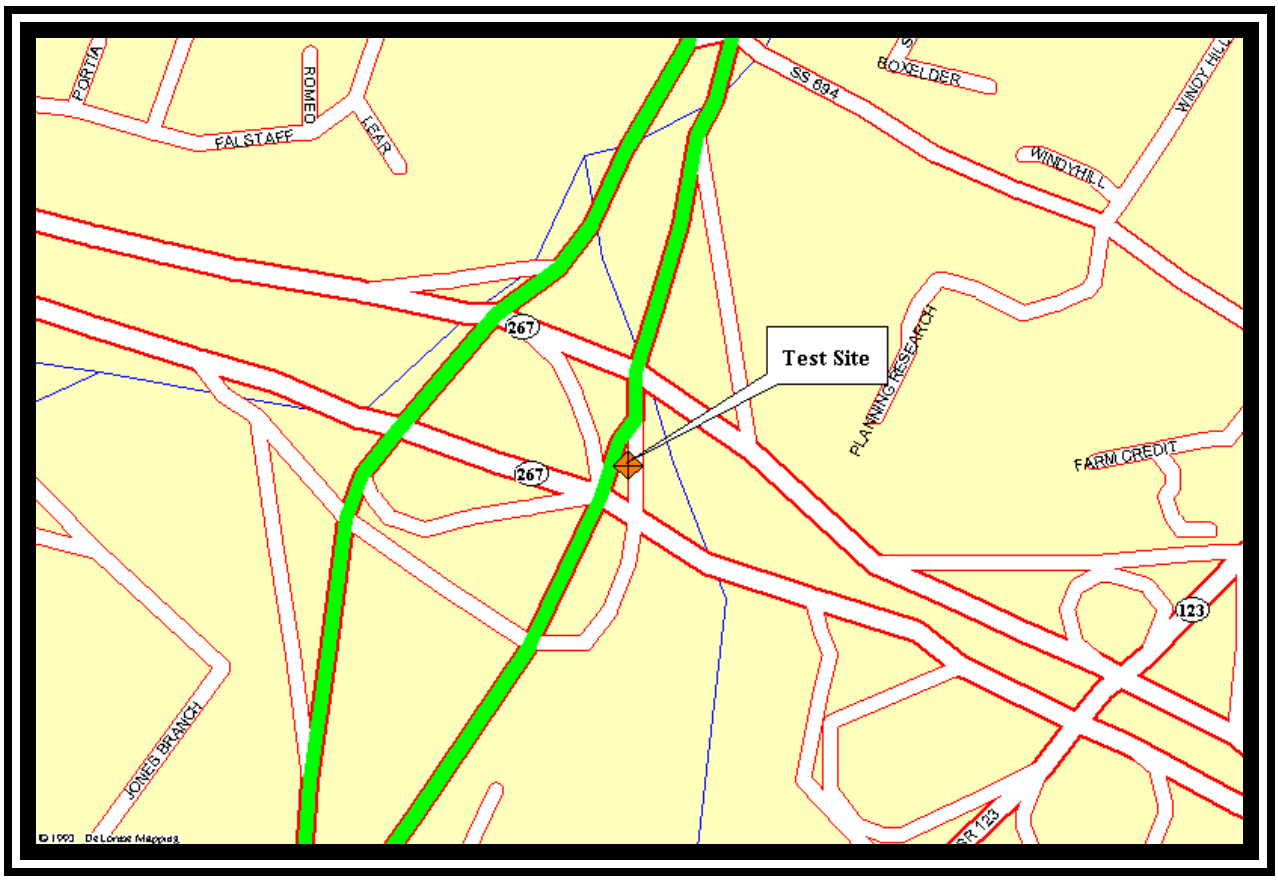
Tyson’s Corner, VA

3.8 Tysons Corner, Virginia – The approach onto the inside of I495 beltway from Dulles Toll road

- Figure 3.8-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.8-2 is the photographs depicting the test site.

- Figure 3.8-3 is the RF spectrum photographs depicting the interference environment at the test site.



Site Location: The approach onto I-495 (Inside of Beltway) from Dulles Toll road at Tysons Corner,Virginia.

Type Environment: Busy Interstate Highway

GPS Coordinates (NAD 83): 38 55 54.3 N
77 12 35.4 W

Date/Time of Measurement: October 18, 2000/ 11:30 AM to 12:00 AM

Engineering Comments: This site was chosen to show the expected ignition noise interference coming from high volumes of vehicle traffic.

Figure 3.8-1 Measurement Site Date Sheet

The approach onto I-495 (Inside of Beltway) from Dulles Toll road at Tysons Corner,Virginia.

Figure 3.8-2 Test Measurement Site Photographs

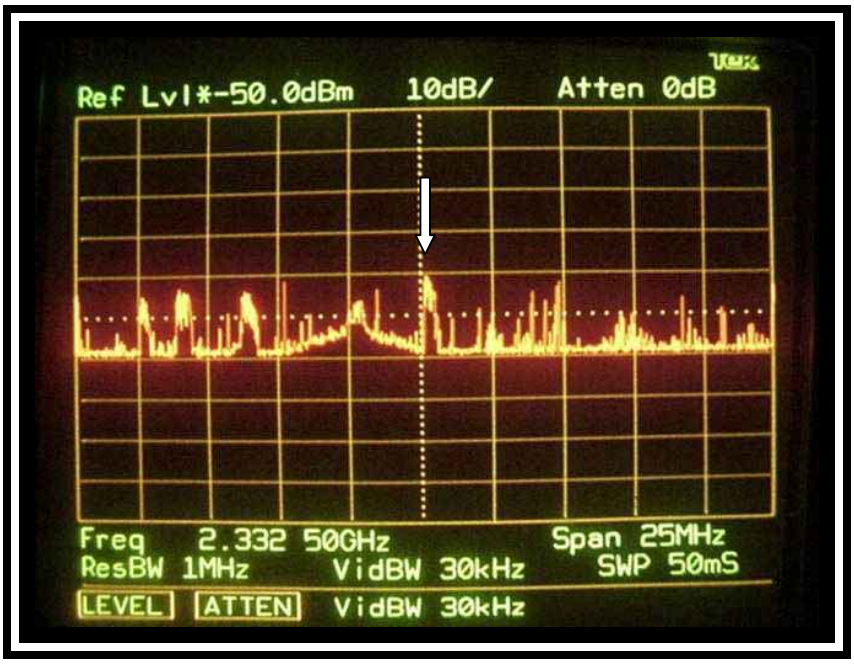
I495 and Dulles Toll Road - Tysons Corner, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 18, 2000
Time of Day: 11:40
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

Traffic passing within 25 feet of the test antenna.

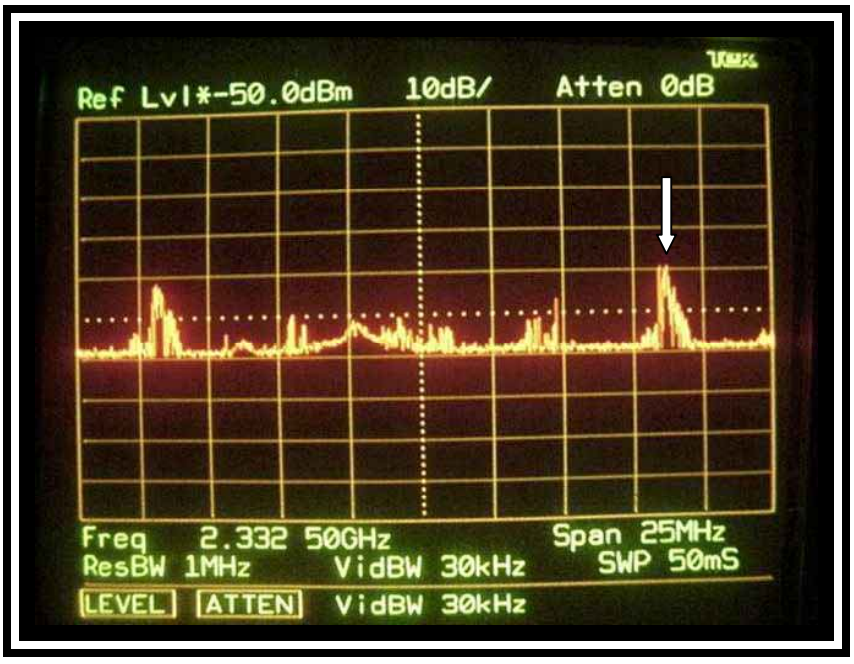
Test antenna is peaked on vehicles passing in front of the test antenna.

Maximum ignition noise interference signal measured was –110 dBm at 2332.8 MHz.

(A)

Reference Level dBm_I

-70



Date: October 18, 2000
Time of Day: 11:42
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

Traffic passing within 25 feet of the test antenna.

Maximum ignition noise interference signal measured was –109 dBm at 2341 MHz.

(B)

Figure 3.8-3 RF Spectrum Analysis

SECTION 3.9

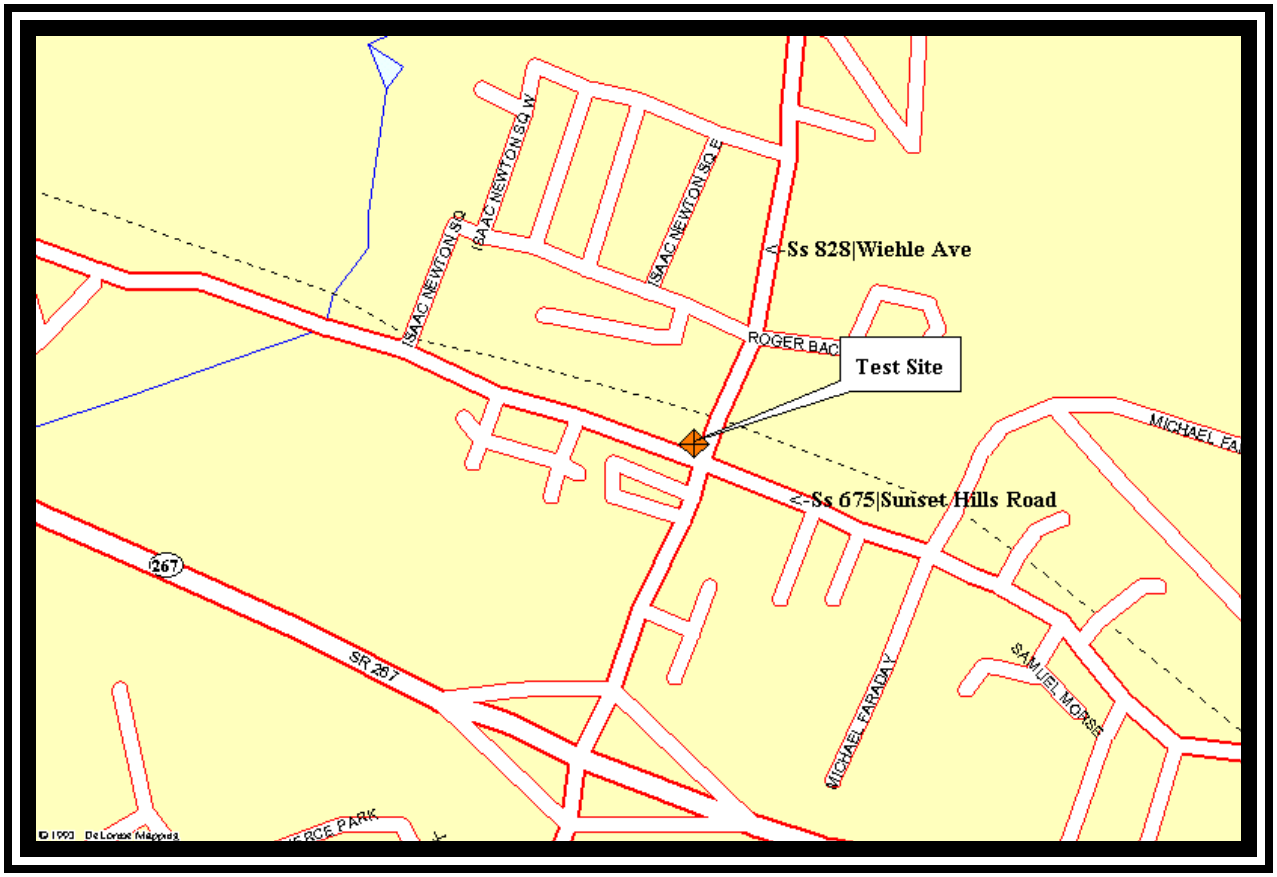
Reston, VA

3.9 Reston, Virginia – Intersection of Sunset Hills and Wiehle

- Figure 3.9-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.9-2 is the photographs depicting the test site.

- Figures 3.9-3 through 3.9-6 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: Intersection of Sunset Hills and Wiehle, Reston, Virginia

Type Environment: Commercial Zone, Busy Road

GPS Coordinates (NAD 83): 38 57 01.2 N
77 20 10.4 W

Date/Time of Measurement: October 18, 2000/ 12:30 PM to 1:45 PM

Engineering Comments: A bus at the intersection provided a classic broadband ignition noise interference case as shown in Figure 3.10-6.

Figure 3.9-1 Measurement Site Date Sheet

:

Intersection of Sunset Hills and Wiehle, Reston, Virginia

Figure 3.9-2 Test Measurement Site Photographs

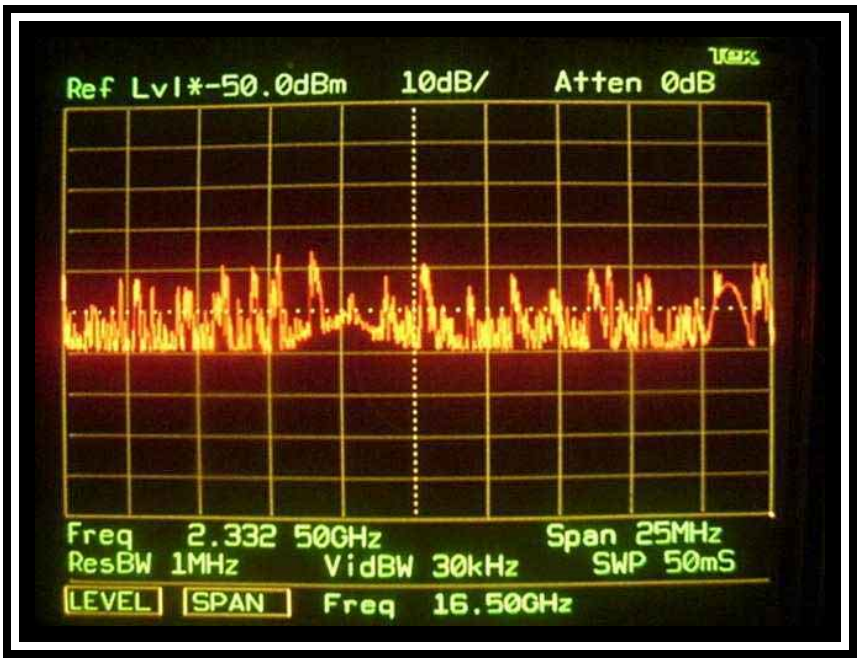
Sunset Hills and Wiehle - Reston, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 18, 2000
Time of Day: 12:43
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

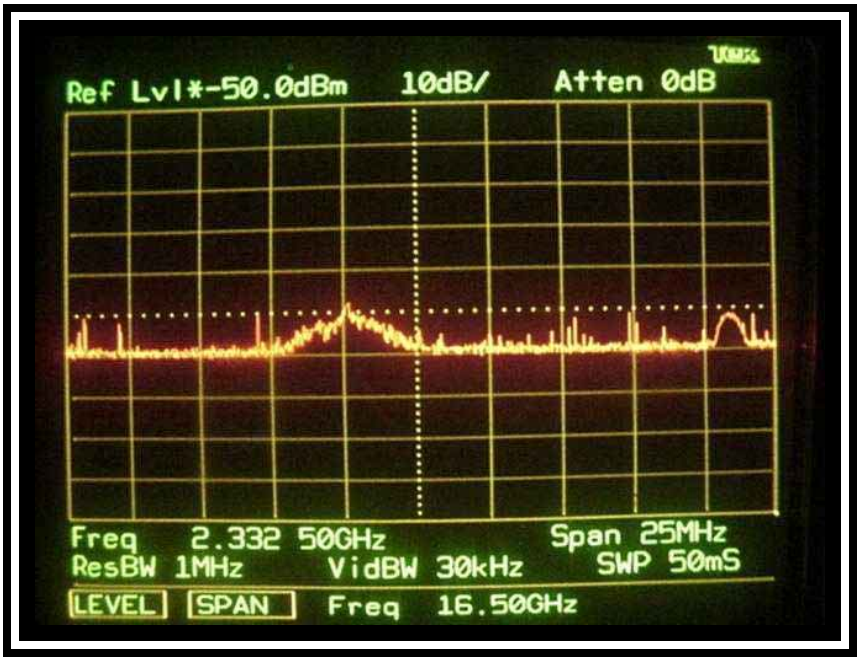
Traffic passing within 20 feet of the test antenna.

Maximum ignition noise interference signal measured was –108 dBm at 2329 MHz.

(A)

Reference Level dBm_I

-70



Date: October 18, 2000
Time of Day: 12:45
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

Traffic passing within 20 feet of the test antenna.

Maximum ignition noise interference signal measured was –121 dBm at 2327 MHz.

(B)

Figure 3.9-3 RF Spectrum Analysis

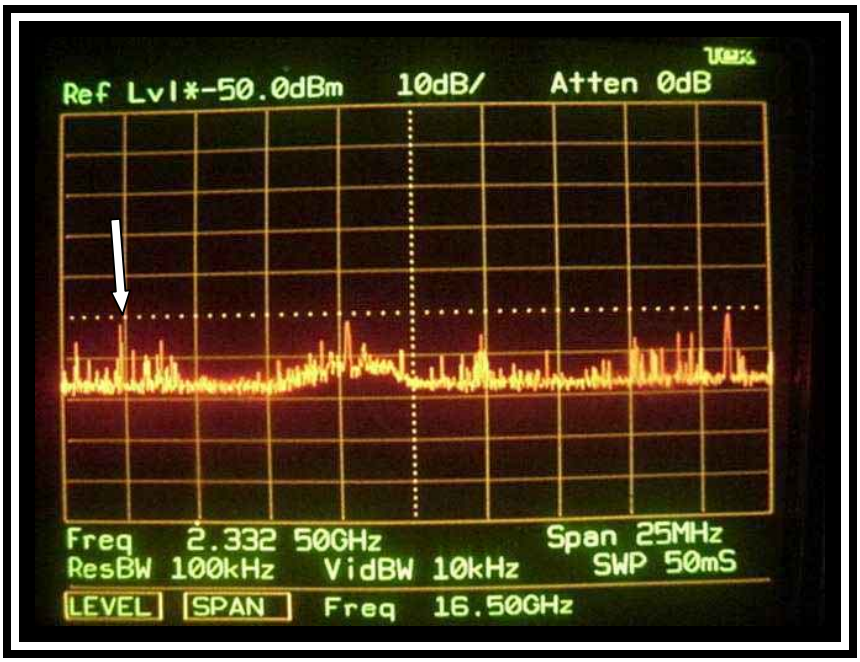
Sunset Hills and Wiehle - Reston, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 18, 2000
Time of Day: 12:51
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

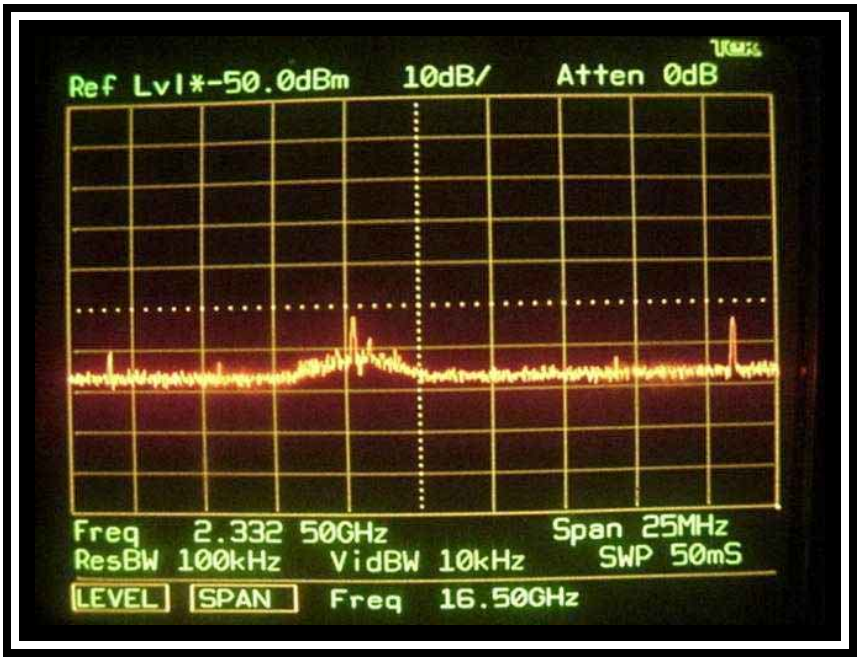
Traffic passing within 20 feet of the test antenna.

Maximum ignition noise interference signal measured was –122 dBm at 2322.3 MHz.

(A)

Reference Level dBm_I

-70



Date: October 18, 2000
Time of Day: 12:49
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

Traffic passing within 20 feet of the test antenna.

Maximum ignition noise interference signal measured was –131 dBm at 2321.5 MHz.

(B)

Figure 3.9-4 RF Spectrum Analysis

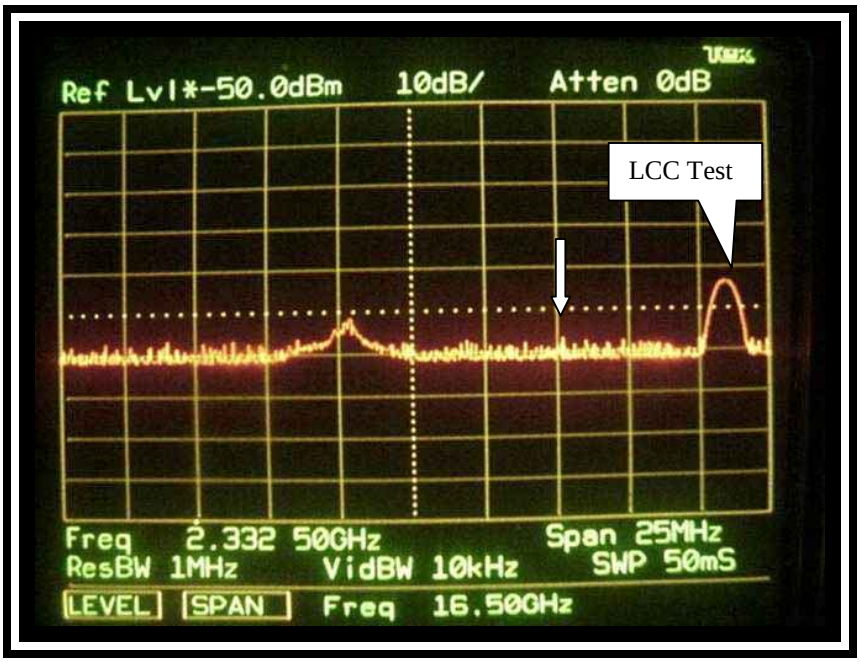
Sunset Hills and Wiehle - Reston, Virginia

Reference Level dBm_I

Azimuth 145°/Elevation 10°

XM Satellite Radio

-70



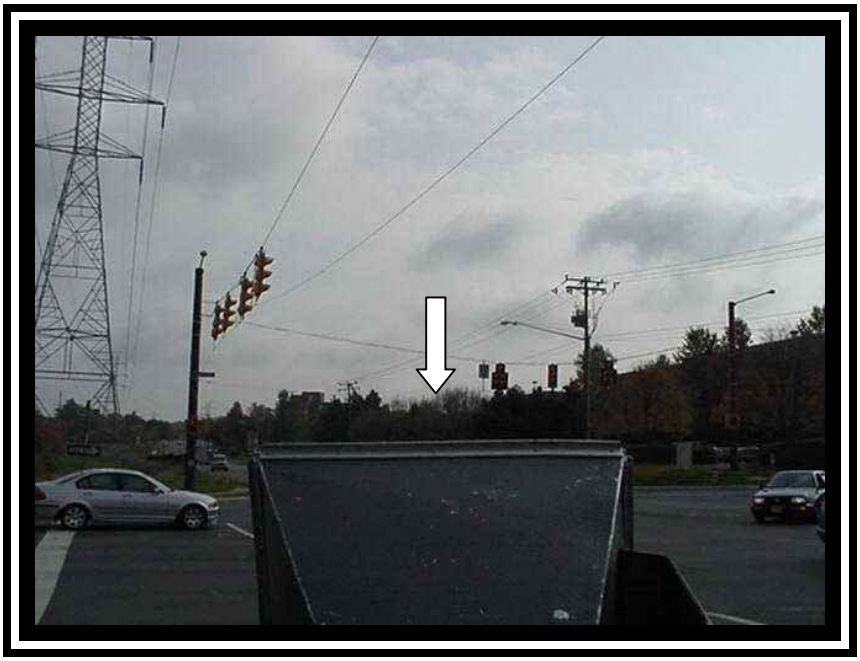
(A)

Date: October 18, 2000
Time of Day: 12:55
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Highest Recorded Signal:

MHz	Level (dBm_I)
2337.8	**-125***

* Maximum vehicle ignition noise measured as indicated by arrow.



(B)

Photograph shows the direction of vehicle ignition noise measured above.

Figure 3.9-5 RF Spectrum Analysis

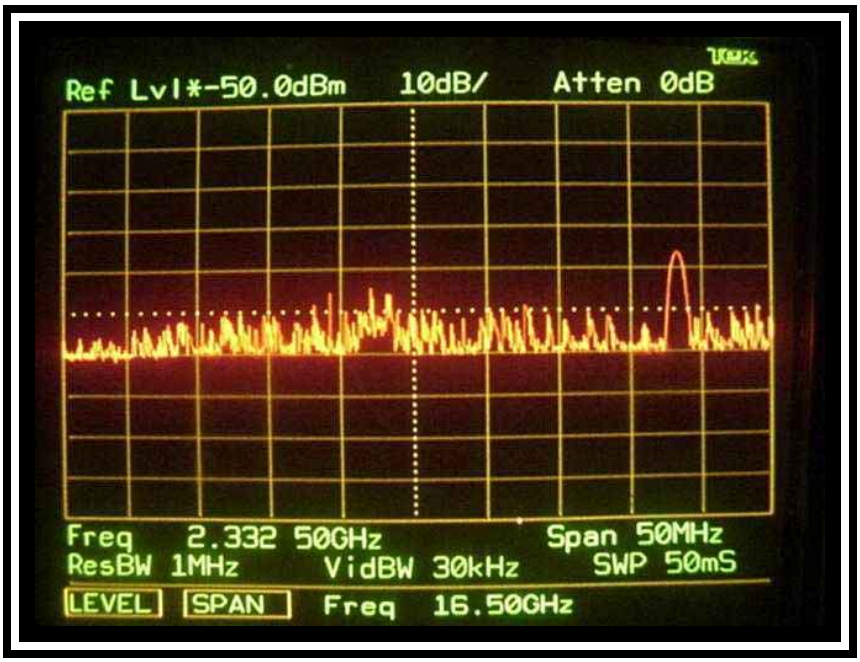
Sunset Hills and Wiehle - Reston, Virginia

Reference Level dBm_I

Azimuth 80^o/Elevation -2^o

XM Satellite Radio

-70



(A)

Date: October 18, 2000
Time of Day: 13:40
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Test antenna is peaked towards the bus as pictured below. The bus is approximately 25 feet away.

Highest Recorded Signal:

MHz	Level (dBm_I)
2329	**-115.0***

*** Maximum vehicle ignition noise measured as indicated by arrow. Measurement frequency span increased to show broadband noise throughout spectrum.**

(B)

Photograph shows the bus that the broadband noise was coming from as viewed above.

Figure 3.9-6 RF Spectrum Analysis

SECTION 3.10

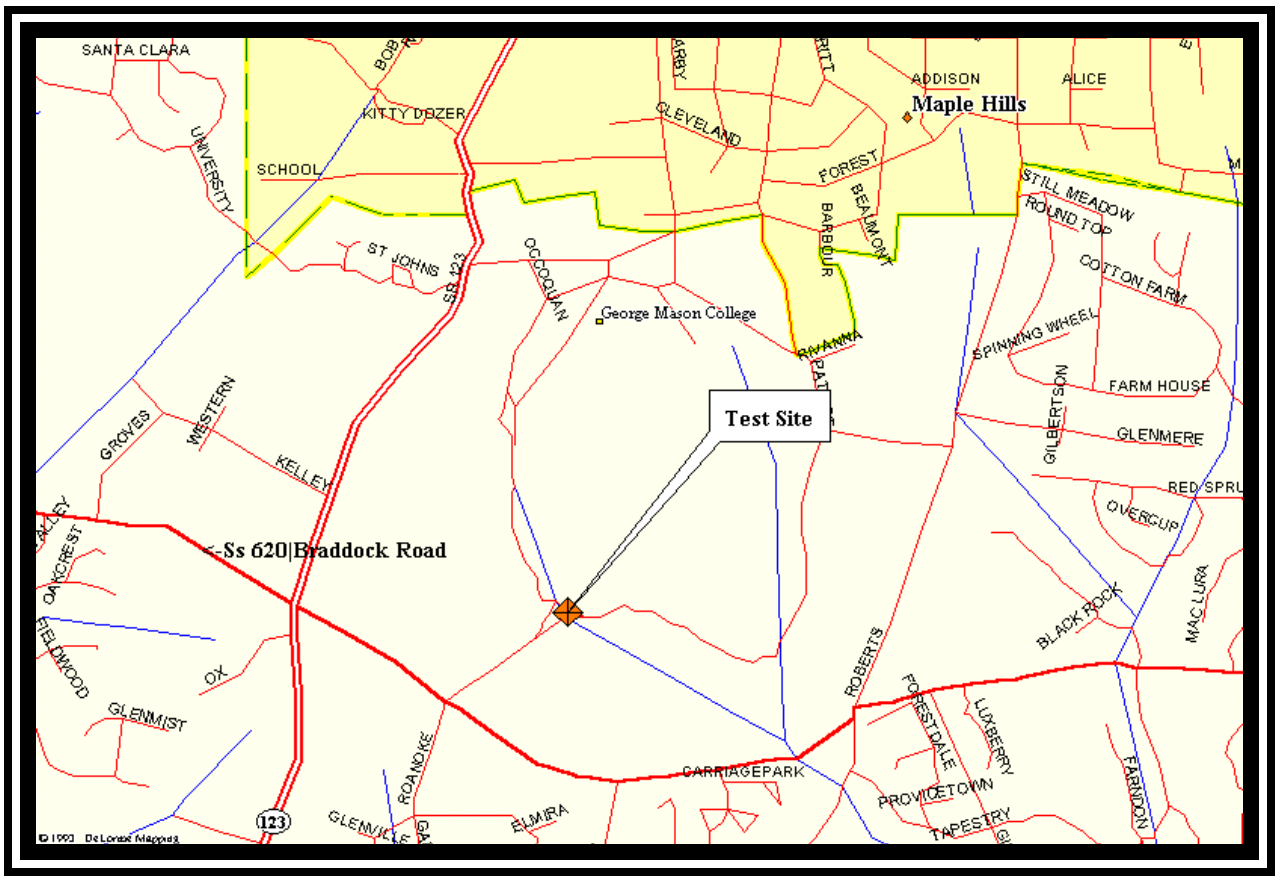
Maple Hills, VA

3.10 Maple Hills, Virginia – George Mason University, on Roanoke Road by the Art Center

- Figure 3.10-1 presents a site data sheet including all pertinent site information and a site map.

- Figure 3.10-2 is the photographs depicting the test site.

- Figures 3.10-3 through 3.10-4 are the RF spectrum photographs depicting the interference environment at the test site.



Site Location: George Mason University, Maple Hills, Virginia

Type Environment: College Campus

GPS Coordinates (NAD 83): 38 49 40.1 N
77 18 37.0 W

Date/Time of Measurement: October 19, 2000/ 12:00 AM to 12:30 AM

Figure 3.10-1 Measurement Site Date Sheet

George Mason University, Maple Hills, Virginia

Figure 3.10-2 Test Measurement Site Photographs

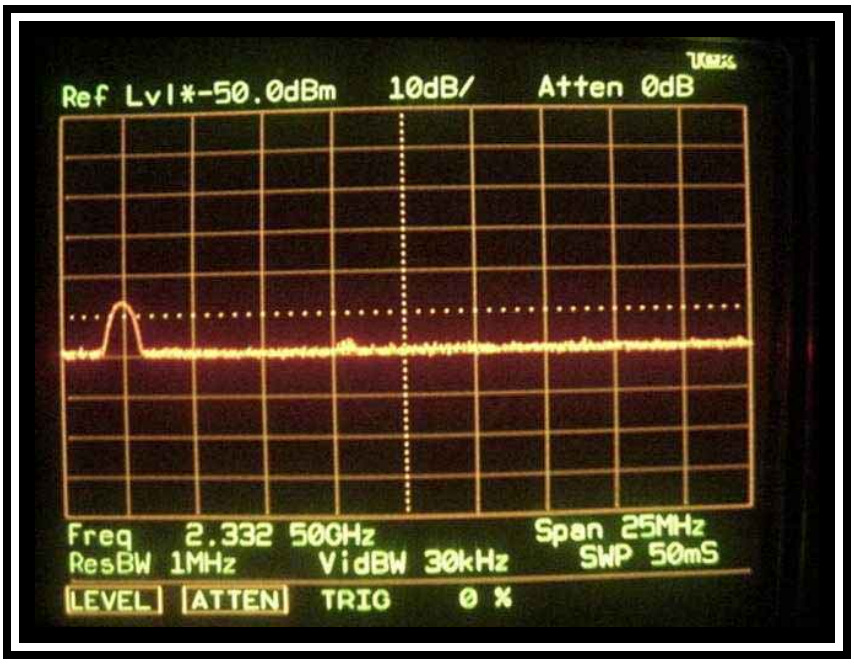
George Mason University - Maple Hills, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



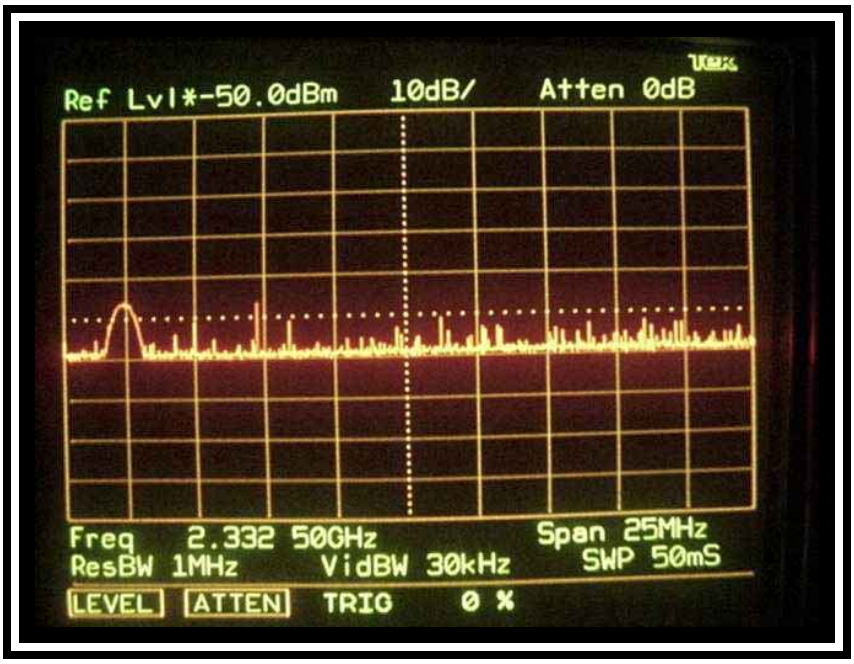
Date: October 19, 2000
Time of Day: 12:04
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

(A)

Reference Level dBm_I

-70



Date: October 19, 2000
Time of Day: 12:05
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

Traffic passing within 10 feet of the test antenna.

Maximum ignition noise interference signal measured was –116 dBm at 2327.25 MHz.

(B)

Figure 3.10-3 RF Spectrum Analysis

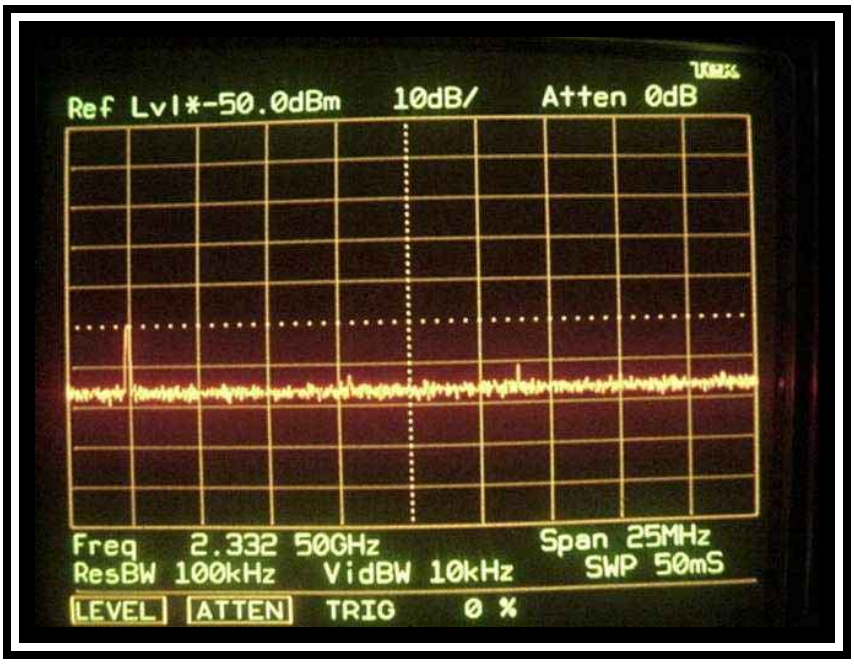
George Mason University - Maple Hills, Virginia

Reference Level dBm_I

Azimuth 0-360°

XM Satellite Radio

-70



Date: October 19, 2000
Time of Day: 12:08
Ant. Polarization: V
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

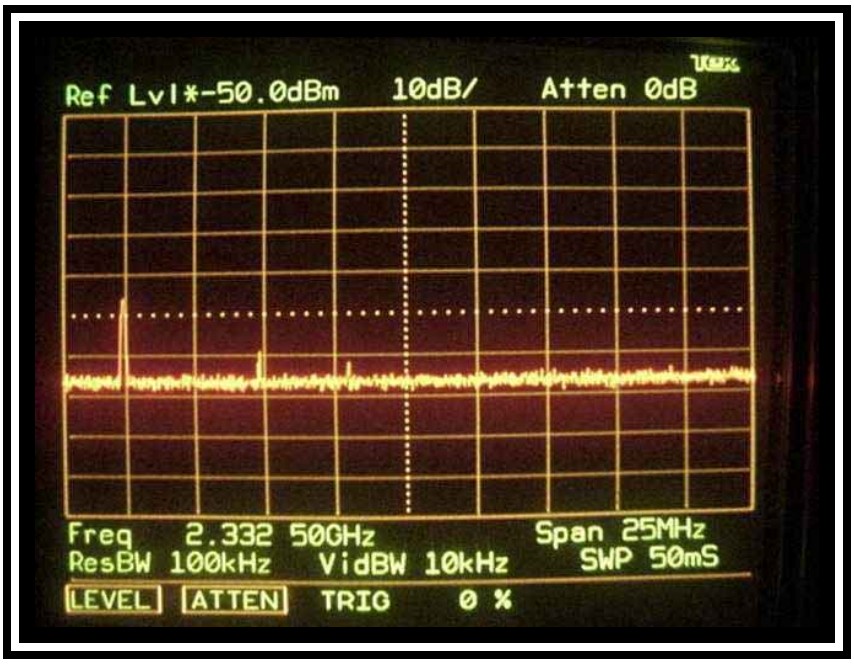
Traffic passing within 10 feet of the test antenna.

Maximum ignition noise interference signal measured was –131 dBm at 2336.25 MHz.

(A)

Reference Level dBm_I

-70



Date: October 19, 2000
Time of Day: 12:06
Ant. Polarization: H
Ant. Centerline: 5 Ft.

Full Antenna Sweep

100 kHz Resolution Bandwidth

Traffic passing within 10 feet of the test antenna.

Maximum ignition noise interference signal measured was –129 dBm at 2327.4 MHz.

(B)

Figure 3.10-4 RF Spectrum Analysis

SECTION

FOUR

SECTION 4

SUMMARY OF RESULTS

This section presents results of measurements performed at the10 locations in Northern Virginia by Comsearch on behalf of XM Satellite Radio during the period of October 9 to October 19, 2000.

During the measurement period, testing of the terrestrial portion of the XM Satellite Radio network was being conducted by LCC. As these signals were being generated as part of the network testing and will not in themselves cause interference to XM Satellite Radio reception, the effect of theses measured signals are not considered in these summary of results. The table below summarizes the relevant measured signals observed within the XM Satellite Radio band (2332.5 – 2345.0 MHz).

Location	Frequency	Max Level/1MHz	Source	Figure
Baileys Crossroads	*Broadband*	*-108 dBm*	*Vehicles Ignition*	*3.1-4A*
Hechinger	*Broadband*	*-120 dBm*	*Vehicles Ignition*	*3.2-3A*
Surveyor Court	2342 MHz	-124.6 dBm	Brinks Protection	3.3-5A
Chestnut	*Broadband*	*-122 dBm*	*Vehicles Ignition*	*3.4-3A*
Hunters Place	No interference found			
St. Andrews	*Broadband*	*-120 dBm*	*Vehicles Ignition*	*3.6-3A*
Santa Maria Court	No interference found			
I-495	*Broadband*	*-109 dBm*	*Vehicles Ignition*	*3.8-3B*

Location	Frequency	Maximum Level	Source	Figure
Sunset Hills	*Broadband*	*-108 dBm*	*Vehicles Ignition*	*3.9-3A*
	Bus	*-115 dBm*	*Bus Ignition*	*3.9-6A*
George Mason Univ.	*Broadband*	*-116 dBm*	*Ignition System*	*3.10-3B*

SECTION

FIVE

SECTION 5

CONCLUSIONS

The results of the electromagnetic measurements performed by Comsearch revealed that the main source of interference in the XM Satellite Radio frequency range of 2332.5 – 2345.0 MHz comes from vehicle ignition noise. Ignition noise levels are a function of both the proximity and number of vehicles present in the measurement area. In addition to the vehicle ignition noise measured at a number of sites, one (1) instance of a signal traced to a home intrusion alarm system was observed and documented. Its level was well below the EINL of the XM-Radio receiver. No other signals were detected in-band that could be considered an interference threat to XM-Radio reception.

Based on the measurements and data assessments performed during this project in the Northern Virginia area, it is concluded that the band of operation for the XM-Radio system is electromagnetically quiet enough at the present time to allow XM-Radio receivers to utilize it without suffering from degrading interference.